



Repair Manual

Golf Variant 2007 ➤
Golf Variant 2010 ➤
Jetta 2005 ➤

Engine Mechanical, Fuel Injection and Ignition									
Engine ID	CBT A	CBU A	CCC A	BGP	BGQ	BTK			

Edition 10.2014



List of Workshop Manual Repair Groups

Repair Group

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Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.



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00 – General, Technical Data

1 General Information

(Edition 10.2014)

⇒ [“1.1 Safety Precautions”, page 1](#)

⇒ [“1.2 Repair Information”, page 3](#)

1.1 Safety Precautions

⇒ [“1.1.1 Safety Precautions, Working on Fuel Supply System”, page 1](#)

⇒ [“1.1.2 Road Test with Testing Equipment Safety Precautions”, page 2](#)

⇒ [“1.1.3 Cooling System Safety Precautions”, page 2](#)

⇒ [“1.1.4 Ignition System Safety Precautions”, page 3](#)

1.1.1 Safety Precautions, Working on Fuel Supply System



WARNING



Fuel lines are under pressure.

Danger of personal injury to eyes and skin.

Wear protective eyewear and protective clothing in order to avoid injury and contact with the skin. Wrap a cloth around the connection before loosening hose connections. Open the connection carefully and release the pressure.

For safety reasons, switch off the current to the fuel pump before opening the fuel system. Otherwise, the fuel pump will activate when the driver door opens or when the ignition switches on. It is possible to interrupt the current flow by using one of the following possibilities:

◆ ***Disconnecting the battery***

or

◆ ***Remove the Transfer Fuel Pump - G6- fuse.***

or

◆ ***Disconnect the connector on the fuel delivery unit flange.***

Always observe the following when removing and installing the fuel level sensor or the fuel pump (fuel delivery unit) from full or partially filled fuel tanks.

- ◆ Before starting work, switch the exhaust extraction system on and place an extraction hose close to the fuel tank installation opening to extract fuel fumes. If no exhaust extraction system is available, a radial fan (as long as motor is not in air flow) with a displacement greater than 15 m³/h can be used.
- ◆ Do not let fuel come in contact with bare skin. Wear fuel-resistant gloves.



Caution

Note the following whenever working inside the engine compartment due to limited space:

- ◆ *Route all lines and cables in their original locations.*
- ◆ *Ensure sufficient clearance to all moving or hot components.*

1.1.2 Road Test with Testing Equipment Safety Precautions

If special testing equipment is required during road test, note the following:

- ◆ Test equipment must always be secured to the rear seat and operated from there by a second person.

If the vehicle is involved in a collision while testing and measuring equipment is operated from the front passenger seat, the person sitting in that seat could be seriously injured when the airbag deploys.

1.1.3 Cooling System Safety Precautions



WARNING

The coolant system is under pressure when the engine is warm.

Risk of scalding due to hot steam and hot coolant.

Reduce pressure by covering coolant reservoir cap with a cloth and carefully opening.



Caution

Note the following whenever working inside the engine compartment due to limited space:

- ◆ *Route all lines and cables in their original locations.*
- ◆ *Ensure sufficient clearance to all moving or hot components.*



Note

- ◆ *When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing repair work.*
- ◆ *Secure all hose connections with hose clamps, allocation. Refer to the Parts Catalog.*
- ◆ *The Spring Clip Pliers - VAS6499- are recommended for installing spring clamps.*
- ◆ *Replace the gaskets and seals.*
- ◆ *Arrows on coolant pipes and coolant hoses must line up across from each other.*



1.1.4 Ignition System Safety Precautions

To reduce the risk of personal injury and/or damage to the fuel injection and ignition system, always observe the following:

- ◆ Do not touch or remove ignition wires when engine is running or turning at starter speed.
- ◆ Only disconnect and reconnect wires for injection and ignition system, including test leads, if ignition is turned off.



Caution

Note the following whenever working inside the engine compartment due to limited space:

- ◆ **Route all lines and cables in their original locations.**
- ◆ **Ensure sufficient clearance to all moving or hot components.**

1.2 Repair Information

⇒ **"1.2.1 Clean Working Conditions", page 3**

⇒ **"1.2.2 Engine Contaminants", page 3**

1.2.1 Clean Working Conditions

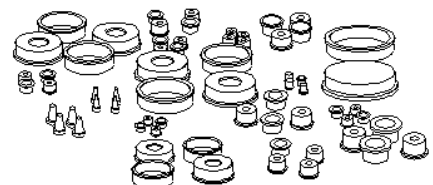
When working on the fuel supply/injection system, pay careful attention to the following "5 rules" of cleanliness:

- ◆ Thoroughly clean the connecting points and the surrounding area before loosening.
- ◆ Place the removed parts on a clean surface and cover them. Only use lint-free cloths!
- ◆ Carefully cover or seal opened components if the repair will not be done immediately.
- ◆ Install only clean parts: remove the replacement parts from their packaging just before installing them. Do not use parts that have been stored loose (for example, in tool boxes etc.).
- ◆ When the fuel system is open: avoid working with compressed air if possible. Do not move vehicle unless absolutely necessary.

1.2.2 Engine Contaminants

- ◆ Close off any open intake or exhaust channels with plugs whenever working on the engine to prevent contaminants from getting in. Use the plugs from Engine Bung Set - VAS6122- .

VAS 6122



W00-10435



2 Description and Operation

⇒ "2.1 Engine Number/Engine Characteristics", page 4

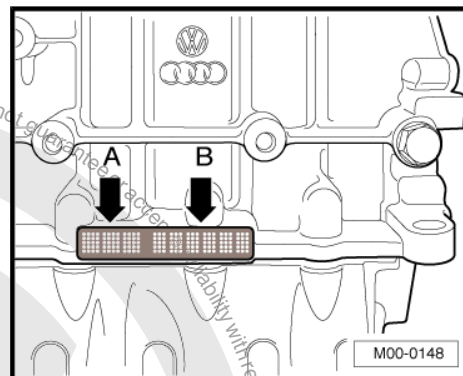
2.1 Engine Number/Engine Characteristics

Engine code -arrow A- and engine number -arrow B- ("serial number") are located on rear side of engine, above partition of cylinder block/upper section of oil pan.

The engine number consists of up to nine characters (alphanumeric). The first part (maximum 3 letters) represents the "engine code", the second (six digit) is the "serial number". If more than 999,999 engines with the same engine code are produced, the first of the six characters is replaced with a letter.

In addition, a sticker with "engine code and engine number" is applied on the cylinder head cover.

The engine code letters are also located on the vehicle data plate. Data plate is located as well in customer service plan as well as on vehicle at rear in the spare wheel well or on the luggage compartment floor.



Vehicles with four-digit engine codes

Four-digit engine codes are used. The first three digits describe the mechanical structure of the engine and are still stamped on the engine, as before. The fourth digit describes the engine output and torque and depends on the engine control module. The four-digit engine code is on the type label, the vehicle data sticker and the engine control module.



Note

Vehicles for some countries do not have a type label. Vehicle data sticker and type label locations. Refer to Maintenance.

Engine Data

Engine Code	CBTA	CBUA	CCCA
Manufactured	From 07/2007	From 07/2007	From 07/2007
Emission values in accordance with	through MY 2009: ULEV 2 ²⁾ from MY 2010: TIER 2/BIN% (US coalition)	SULEV ³⁾	TIER 1 MEX ⁴⁾ / Fase IV ⁵⁾ / EU2 DDK
Displacement cm ³	2480	2480	2480
Output kW at RPM	125/5700	125/5700	125/5700
Torque Nm at RPM	240/4250	240/4250	240/4250
Bore diameter in mm	82.5	82.5	82.5
Stroke mm	92.8	92.8	92.8
Compression ratio	9.5	9.5	9.5
Valves per cylinder	4	4	4
RON minimum	95 unleaded ⁶⁾	95 unleaded ⁶⁾	95 unleaded ⁶⁾
Fuel injection, ignition	through 05/2008: Motronic ME 7.1.1 from 06/2008: ME 17.5	through 05/2008: Motronic ME 7.1.1 from 06/2008: ME 17.5	through 11/2008: Motronic ME 7.1.1 from 12/2008: ME 17.5
Knock control	2 sensors	2 sensors	2 sensors
Camshaft adjustment	yes	yes	yes



Engine Code	CBTA	CBUA	CCCA
Variable intake manifold	no	no	no
Oxygen sensor regulation	2 sensors	3 sensors	2 sensors
Catalytic Converter	yes	yes	yes
Exhaust Gas Recirculation (EGR)	no	no	no
Turbocharger, G-Charger	no	no	no
Secondary Air Injection System	through MY 2009: yes from MY 2010: no	yes	yes ¹⁾

- 1) Only for vehicles in Brazil
- 2) ULEV 2: Ultra Low Emission Vehicles
- 3) SULEV: Super Ultra Low Emission Vehicles
- 4) according to Mexico Exhaust Gas Standard NOM-042-SEMARNAT-2003
- 5) according to resolution No. 15, dated 12/13/1995 from Conama
- 6) Also 91 RON, but with reduced performance.





10 – Engine Assembly

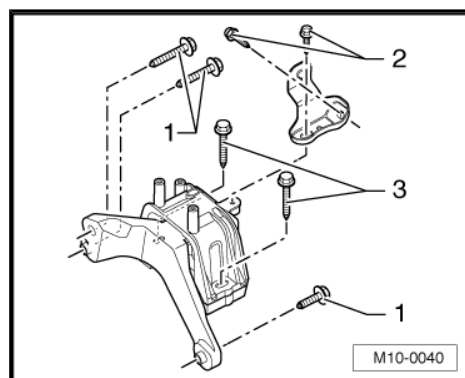
1 Description and Operation

⇒ “1.1 Overview - Subframe Mount”, page 6

1.1 Overview - Subframe Mount

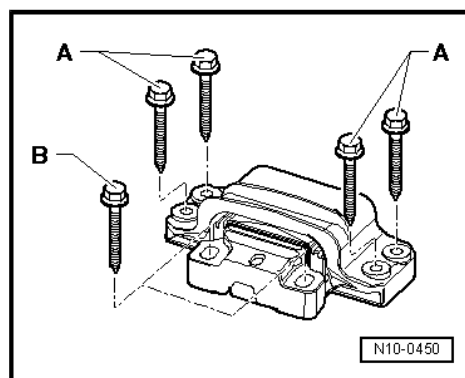
Engine Mount

- 1 - = 40 Nm + 90° (1/4 turn) additional turn, replace the bolts
- 2 - = 20 Nm + 90° (1/4 turn) additional turn, replace the bolts
- 3 - = 60 Nm + 90° (1/4 turn) additional turn, replace the bolts



Transmission Mount

- A - = 40 Nm + 90° (1/4 turn) additional turn, replace the bolts
- B - = 60 Nm + 90° (1/4 turn) additional turn, replace the bolts



Pendulum Support



Note

Attach the pendulum support to the transmission first and then to the subframe.

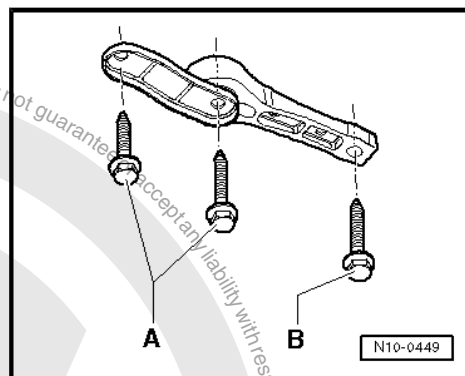
A - Strength category 8.8 = 40 Nm + 90° (1/4 turn) additional turn, replace the bolts

A - Strength class 10.9 = 50 Nm + 90° (1/4 turn) additional turn - replace the bolts

B - 100 Nm + 90° (1/4 turn) additional turn, replace the bolt

Removing: remove the bolt -B- first and then the bolts -A-.

Installing: first tighten the bolt -A- and then bolt -B-.





2 Removal and Installation

⇒ [“2.1 Engine, Removing”, page 7](#)

⇒ [“2.2 Engine, Securing on Assembly Stand”, page 12](#)

⇒ [“2.3 Engine, Installing”, page 14](#)

2.1 Engine, Removing

Special tools and workshop equipment required

- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Engine and Gearbox Jack - VAS6931-
- ◆ Hose Clip Pliers
- ◆ Step Ladder - VAS5085-
- ◆ Engine Holder Bracket - T03000-
- ◆ Cable Tie
- ◆ Foam Mat
- ◆ Tensioning Strap - T10038-

Procedure



Note

- ◆ *To perform work sequence, the ground cable must be disconnected from battery. Check whether a coded radio is installed. If so, obtain anti-theft coding beforehand.*
- ◆ *The engine is removed downward together with the transmission.*
- ◆ *All cable ties which are opened or cut open when removing engine, must be replaced in the same position when installing engine.*
- ◆ *Seal off the disconnected fuel and ventilation lines to prevent dirt from getting into the system.*
- ◆ *Leave the key in the ignition lock to prevent the steering wheel from locking.*
- ◆ *If engine oil must be drained because of work performed on the removed engine, it should be performed with the engine installed. If engine hangs on the Engine And Transmission Holder - Engine Lateral Bracket - T03001-, the engine is not in installation position and less engine oil flows out.*



Caution

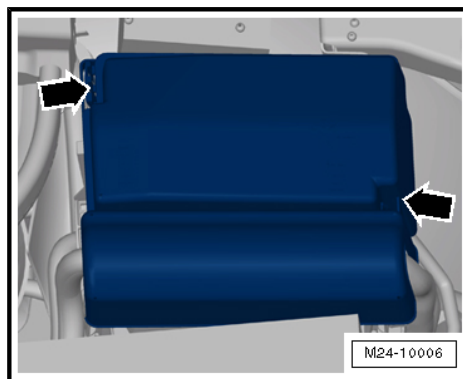
When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.*



- Check the DTC memories for all the control modules using the Vehicle Diagnostic Tester .
- Remove the engine cover with air filter. Refer to ➔ [“4.1 Engine Cover with Air Filter”, page 216](#) .
- Remove the battery. Refer to ➔ Electrical Equipment; Rep. Gr. 27 ; Battery; Removing and Installing; Vehicles with Gasoline Engine .
- Remove the E-box cover inside the engine compartment -arrows-.

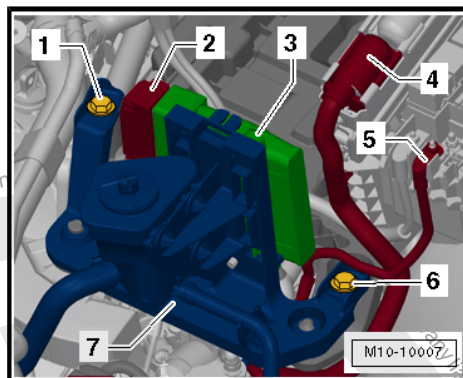
Vehicles with an automatic transmission



- Unclip the transmission control module -3- from the bracket -7- and remove it upward.
- Disconnect the connector -2- from the transmission control module.

Continuation for all vehicles

- Remove the bolts -1- and -6-.
- Move the bracket -7- with the power steering fluid reservoir to the side.
The hoses remain connected.
- Remove the wire -2- and free up.
- Disconnect the connector -4- from the engine control module and free up the engine wiring harness. Refer to ➔ [“4.5 Engine Control Module, through 10/2008”, page 223](#) .
- Remove the battery tray.
- Disconnect the connector -4-, open the locking mechanism and lay the engine wiring harness -3- on the engine.
- Disconnect the ground cable -1- and the starter connections -2- and -5-.

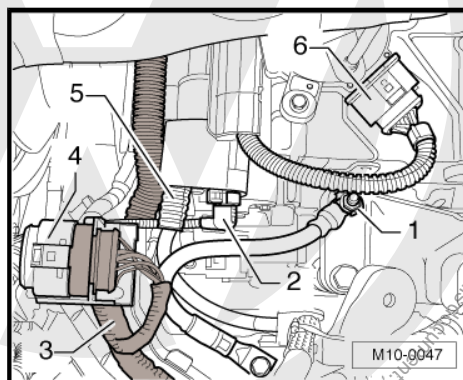


Vehicles with an automatic transmission

- Disconnect the connector -6- from the multifunction switch.
- Remove the selector lever cable from the transmission. Refer to ➔ Automatic Transmission; Rep. Gr. 37 ; Selector Mechanism .

Vehicles with a manual transmission

- Remove shift mechanism from transmission. Refer to ➔ Manual Transmission; Rep. Gr. 34 ; Gearshift Mechanism, Servicing .



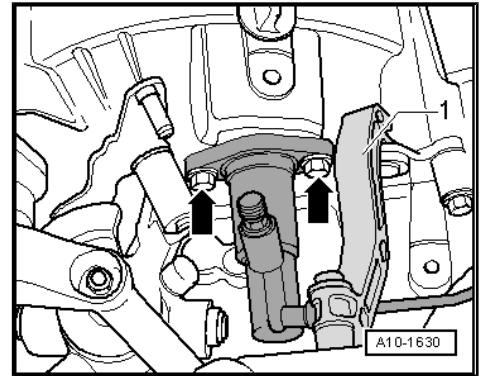


- Remove the brace -1-.
- Remove the clutch slave cylinder -arrows- and move it to the side. Do not open the line system.



Caution

Do not operate the clutch pedal anymore after slave cylinder has been removed. Slave cylinder may be damaged by doing this.



- Disconnect connector for back-up light switch from transmission.

Continuation for all vehicles

- Disconnect vacuum hose from brake booster.
- Disconnect harness connector for Heated Oxygen Sensor - G39- on bulkhead free up wiring harness.
- Open and close the cap on the expansion tank, to relieve the cooling system pressure.
- Remove the right front wheel housing liner. Refer to ➤ Body Exterior; Rep. Gr. 66 ; Wheel Housing Liner; Front Wheel Housing Liner, Removing and Installing .

To facilitate removal and installation of the engine without having to open the refrigerant circuit:

- Remove ribbed belt ➤ [“4.1 Ribbed Belt”, page 43](#) .



WARNING

Refrigerant can cause serious personal injury.

- ◆ *Do not open the A/C system refrigerant circuit.*

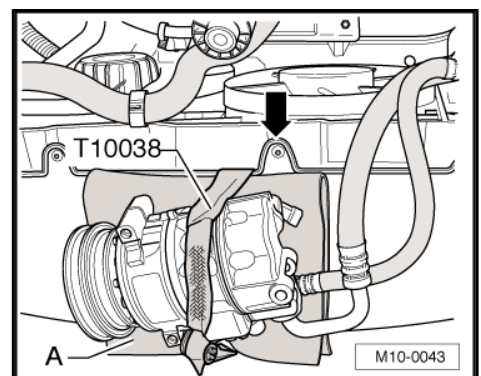


Caution

Danger of causing damage to the refrigerant lines and hoses.

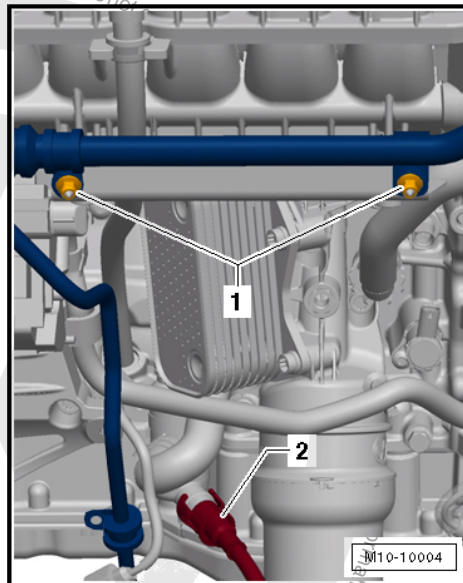
- ◆ *Do not bend, twist or stretch the refrigerant lines and hoses.*

- Remove A/C compressor from bracket for accessories. Refer to ➤ Heating, Ventilation and Air Conditioning; Rep. Gr. 87 ; Compressor Bracket .
- Secure the A/C compressor to the bumper cover using a Tensioning Strap - T10038- and a suitable mat -A-. Slide Tensioning Strap - T10038- as far as possible on to mounting bolt -arrow-.
- Remove the clamps for the power steering pressure line from the transmission. Refer to ➤ Suspension, Wheels, Steering; Rep. Gr. 48 ; Overview - Hydraulic Lines, 4-Cylinder Gasoline Engine .





- Remove the nuts -1- and the power steering pump line.
- If the vehicle has an engine preheater, remove the cable -2-.
- Remove the power steering pump from the auxiliary component bracket. Refer to ➔ Suspension, Wheels, Steering; Rep. Gr. 48 ; Power Steering Pump, 5-Cylinder Gasoline; Power Steering Pump, 5-Cylinder Gasoline, Removing and Installing .
- The power steering lines remain connected to the power steering pump.

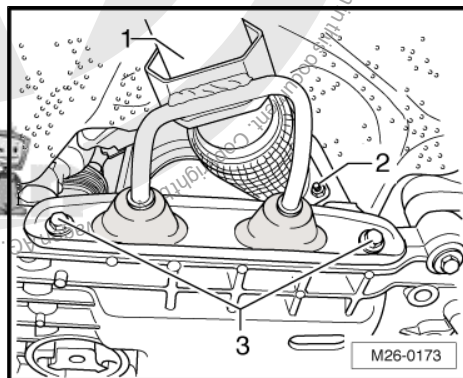


- Remove the four nuts -2- and the bolts -3-.
- Pull off front exhaust pipe -1- from manifold and tie up firmly to the side
⇒ ["4.1 Front Exhaust Pipe with Catalytic Converter, Removing and Installing", page 246](#) .



Note

Flex joint in front exhaust pipe must not be bent more than 10 °, otherwise it may be damaged.



- Remove the right driveshaft and remove the left driveshaft from the transmission. Refer to ➔ Suspension, Wheels, Steering; Rep. Gr. 40 ; Driveshaft, Removing and Installing .
- Remove the subframe and steering gear. Refer to ➔ Suspension, Wheels, Steering; Rep. Gr. 40 ; Overview - Subframe; Subframe and Steering Gear, Removing and Installing .



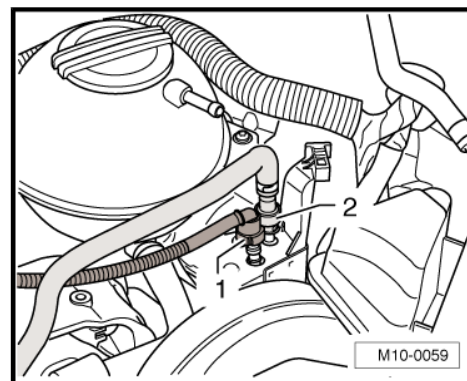
WARNING

Fuel system is under pressure!

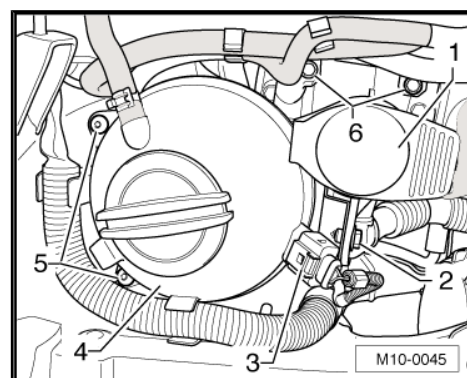
- ◆ ***Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.***
- ◆ ***Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.***



- Disconnect the fuel supply line -2-. Push the locking ring upward and into the housing.
- Disconnect the bleed line -1-. Press the locking ring.
- Seal the lines so that the fuel system is not contaminated by dirt etc.



- Remove the bolt -2- and move the windshield washer reservoir -1- toward the front.
- Remove the connector -3-.
- Remove the bolts -5- and place the coolant expansion tank -4- on top of the engine with the hoses connected.

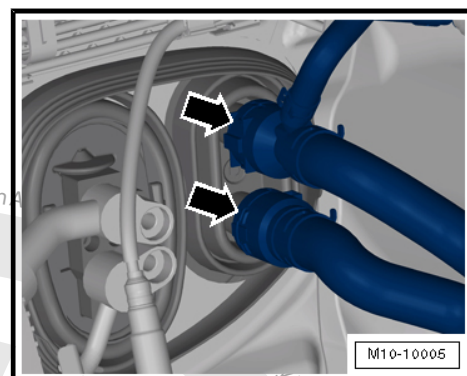


Engine Code CCCA

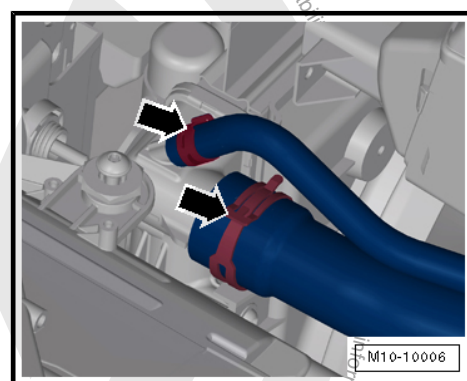
- Remove the ventilation hose from the EVAP canister.
- Remove the EVAP canister.

Continuation for all vehicles

- Remove the coolant hoses from the heat exchanger -arrows-.



- Open the spring clamps -arrows- and remove the coolant hoses from the radiator.



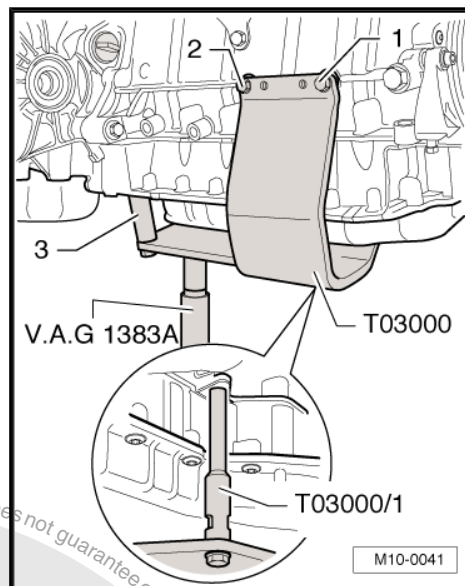


- Install the Engine Holder Bracket - T03000- as follows:
 - ◆ Remove the pins -T03000/1- from the Engine Holder Bracket - T03000- .
 - ◆ Attach the Engine Holder Bracket - T03000- to cylinder block with pin -3- and tighten bolts -1- and -2- hand-tight.
 - ◆ Then install in the engine holder bracket pins -T03000/1- and tighten to 20 Nm.
 - ◆ Then tighten bolts -1- and -2- to 25 Nm.
- Place Engine/Transmission Jack - VAG1383 A- on Engine Holder Bracket - T03000- and lift engine/transmission assembly slightly.



WARNING

Use a step ladder such as Step Ladder - VAS5085- to remove the bolts for the engine/transmission mount.

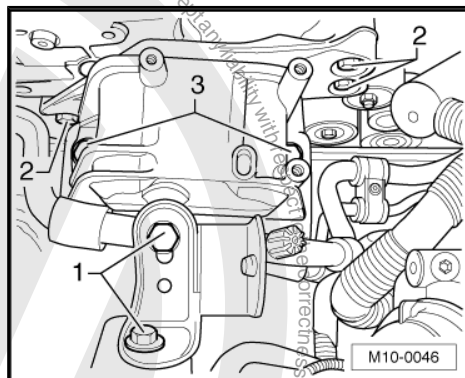


- Remove engine mount from above. To do this, remove the bolts -1-, -2- and -3-.



Note

The rear bolt -2- is accessible through a hole in the wheel housing.

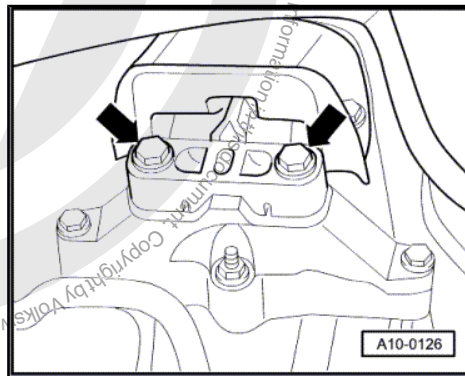


- Remove the transmission mount from the transmission holder -arrows-.



Note

- ◆ Check that all hoses and lines between engine/transmission assembly and body have been disconnected.
- ◆ A second technician is needed to lower the engine/transmission assembly.
- ◆ The engine/transmission assembly must be guided with care to prevent damage while lowering.



- Carefully lower the engine/transmission assembly. When doing this, rotate or push the engine/transmission assembly.

2.2 Engine, Securing on Assembly Stand

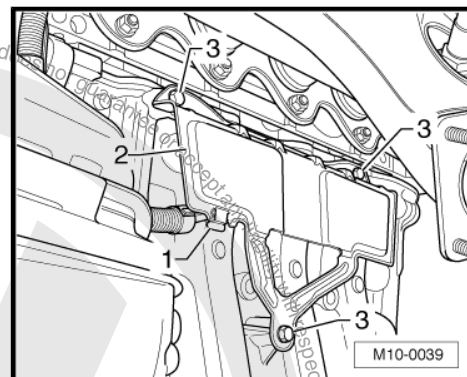
Special tools and workshop equipment required

- ◆ Lifting Tackle - 3033-
- ◆ Shop Crane - VAS6100-
- ◆ Engine And Transmission Holder - VAS6095-
- ◆ Engine And Transmission Holder - Engine Lateral Bracket - T03001-
- ◆ Transport Arm - T03002-

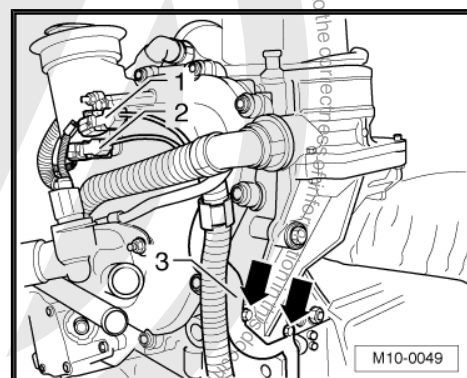


For performing work, secure engine using Engine And Transmission Holder - Engine Lateral Bracket - T03001- to Engine and Gearbox Bracket VAS6095A - VAS6095A- .

- Remove the transmission. Refer to ➤ Rep. Gr. 34 ; Transmission, Removing and Installing or ➤ Rep. Gr. 37 ; Transmission, Removing and Installing .
- Pull off clamp -1- for the wiring harness, remove the bolts -3- and the cover plate -2-.

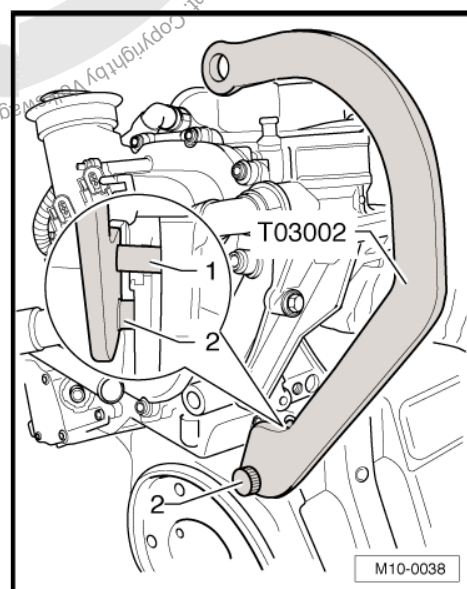


- Disconnect the connectors -1- and -2- and remove the bracket -3- -arrows-.



- Install the Transport Arm - T03002- , as illustrated.

Pin -1- engages in cylinder block. Tighten knurled bolt -2- hand-tight.





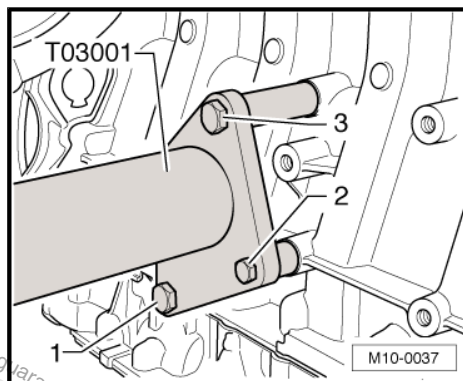
- Install the Engine And Transmission Holder - Engine Lateral Bracket - T03001- .

Tighten bolts -1- and -3- to 40 Nm, bolt -2- to 25 Nm.



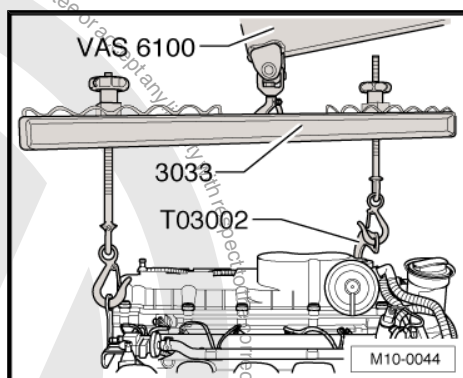
Note

- ◆ Bolts are designed so that they cannot be lost.
- ◆ When removing, the Engine And Transmission Holder - Engine Lateral Bracket - T03001- must be held at tension in direction of removal, otherwise the bolt -1- cannot be removed.



- Engage the Lifting Tackle - 3033- as shown and lift out of the engine using Shop Crane - VAS6100- from Engine/Gearbox Jack - VAG1383 A- .
- Secure the engine to Engine and Transmission Holder - VAS6095- .

Q



2.3 Engine, Installing

Subframe mount. Refer to

⇒ ["1 Description and Operation", page 6](#) .

Install in reverse order of removal. Note the following:



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.
- ◆ To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.

Vehicles with a manual transmission

- Lightly coat the splines on the driveshaft with Lubricating Grease - G 000 100- .
- Install the clutch and clutch mechanism. Refer to ⇒ Manual Transmission ; Rep. Gr. 30 ; Clutch Mechanism, Servicing .

Continuation for all vehicles

- Tighten the engine mount to the engine. Align the engine/ transmission sub-assembly and then tighten the bolts on the subframe mount.



Note

- ◆ *Subframe mount tightening specifications. Refer to*
⇒ "1 Description and Operation", page 6 .
- ◆ *Electrical connections and wiring routing. Refer to ⇒ Electrical*
Equipment; Rep. Gr. 97 .
- Install the subframe. Refer to ⇒ Suspension, Wheels, Steering; Rep. Gr. 40; Overview - Subframe, Stabilizer Bar and Control Arm; Subframe, Removing and Installing .
- Install the front exhaust pipe. Refer to
⇒ "4.1 Front Exhaust Pipe with Catalytic Converter, Removing and Installing", page 246 .
- Install the right drive axle and insert left drive axle or connect to flange. Refer to ⇒ Suspension, Wheels, Steering; Rep. Gr. 40 ; Servicing drive axle; removing and installing drive axles .
- Install the A/C compressor. Refer to ⇒ Heating, Ventilation and Air Conditioning; Rep. Gr. 87 ; A/C Compressor Bracket .
- Install the ribbed belt. Refer to
⇒ "4.1 Ribbed Belt", page 43 .
- Install the noise insulation. Refer to ⇒ Body Exterior; Rep. Gr. 50 ; Noise Insulation .

Vehicles with a manual transmission

- Attach the gearshift mechanism and, if necessary, adjust. Refer to ⇒ Manual Transmission; Rep. Gr. 34 ; Gearshift Mechanism, Servicing .
- Install the clutch slave cylinder for the hydraulic clutch. Refer to ⇒ Rep. Gr. 30 ; Overview - Clutch Mechanism, Servicing; Hydraulic System .

Vehicles with an automatic transmission

- Install the selector lever cable and adjust if necessary. Refer to ⇒ Automatic Transmission; Rep. Gr. 37 ; Selector Mechanism .

Continuation for all vehicles

- Install the engine control module. Refer to
⇒ "4.5 Engine Control Module, through 10/2008", page 223 .
- Install the battery. Refer to ⇒ Electrical Equipment; Rep. Gr. 27 ; Battery, Removing and Installing; Vehicles with Gasoline Engine .
- Bleed the fuel system. Refer to
⇒ "4.6 Fuel System, Bleeding", page 184 .
- Fill the coolant. Refer to
⇒ "4.1 Coolant, Draining and Filling", page 123 .
- Adapt the engine control module. Use the Vehicle Diagnostic Tester "Guided Functions".
- Perform the vehicle system test: Vehicle Diagnostic Tester "Guided Fault Finding".
- Complete "Guided Fault Finding".

Follow all safety precautions during the road test.

- Perform a road test.
- Perform the vehicle system test again and correct any faults.



Tightening Specifications

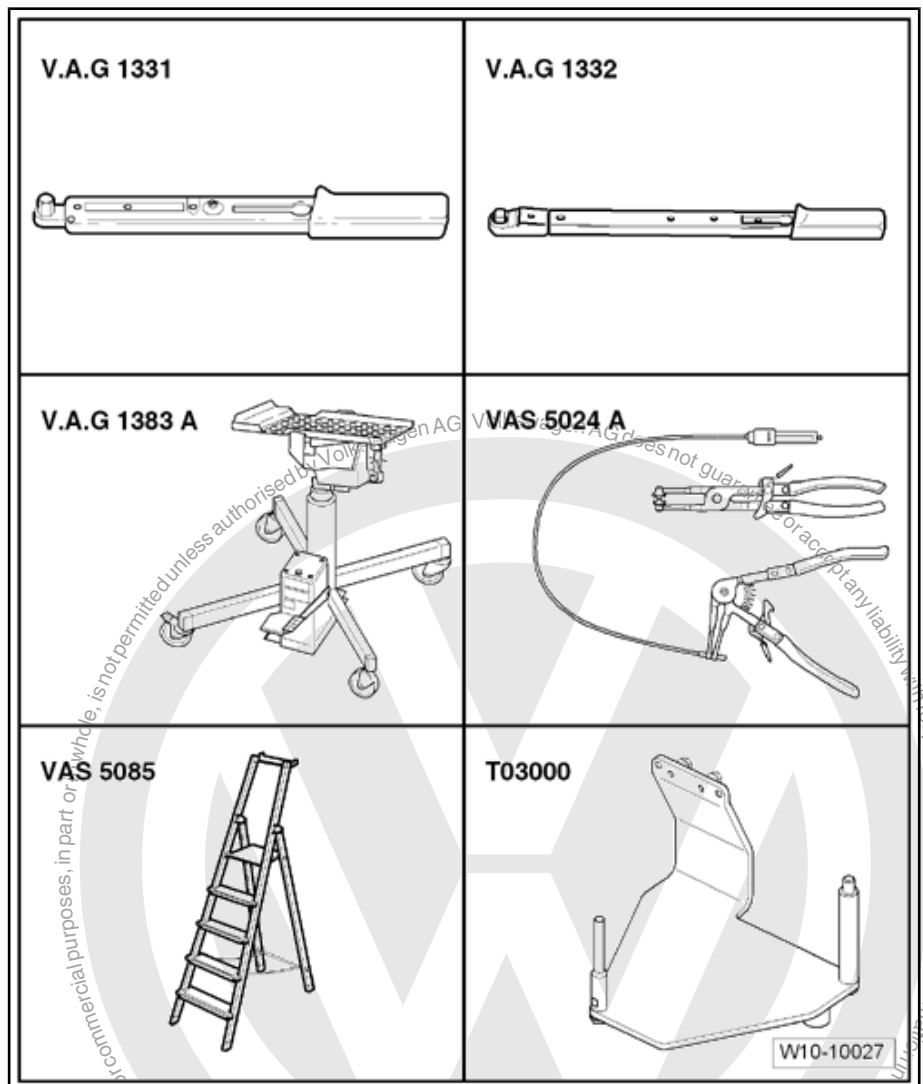
Bolted connections		Tightening Specification
Bolts and Nuts	M6	10 Nm
	M7	15 Nm
	M8	25 Nm
	M10	40 Nm
	M12	60 Nm



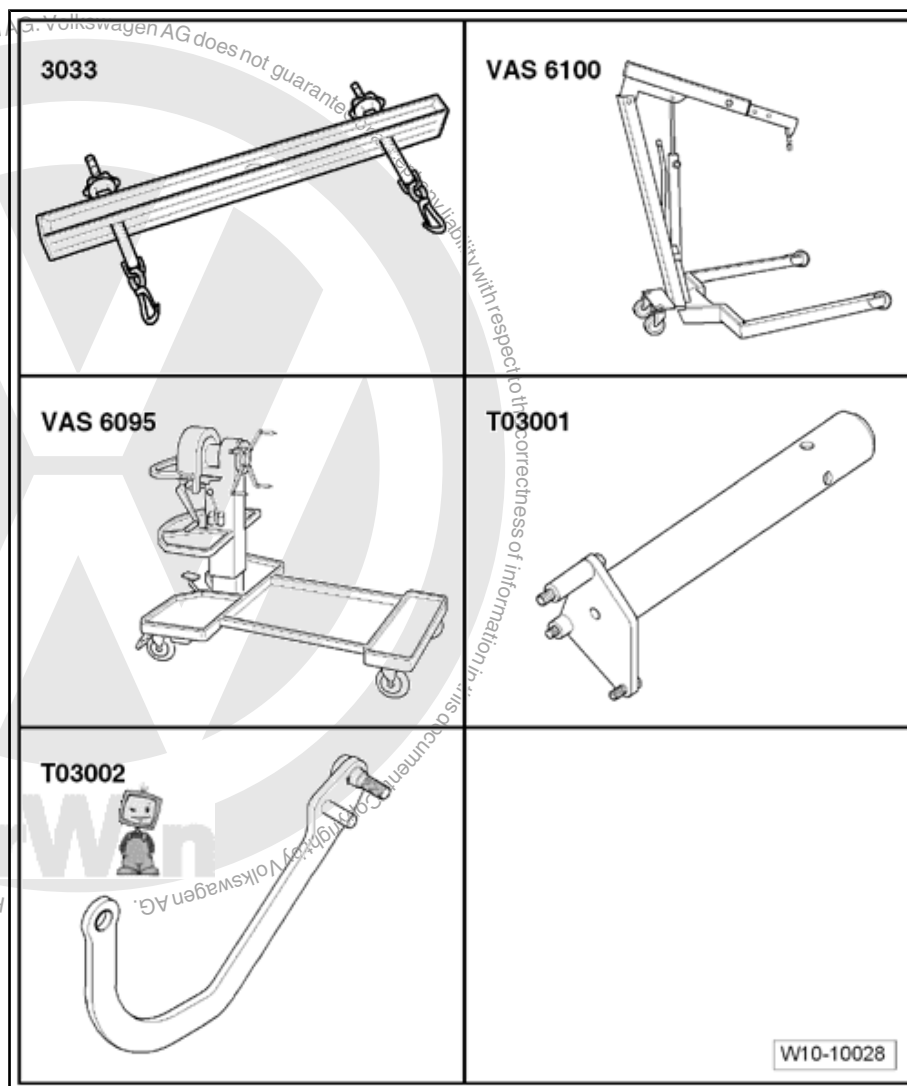


3 Special Tools

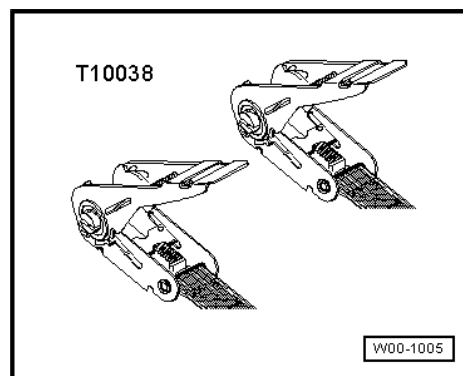
Special tools and workshop equipment required



- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Engine and Gearbox Jack - VAS6931-
- ◆ Hose Clip Pliers - VAS5024A-
- ◆ Step Ladder - VAS5085-
- ◆ Engine Holder Bracket - T03000-



- ◆ Lifting Tackle - 3033-
- ◆ Shop Crane - VAS6100-
- ◆ Engine And Transmission Holder - VAS6095-
- ◆ Engine And Transmission Holder - Engine Lateral Bracket - T03001-
- ◆ Transport Arm - T03002-
- ◆ Tensioning Strap - T10038-





13 – Crankshaft, Cylinder Block

1 General Information

⇒ [“1.1 Engine, Disassembling and Assembling”, page 19](#)

1.1 Engine, Disassembling and Assembling



Note

- ◆ *If large quantities of metal particles or abraded material are detected during engine repairs, it may mean the crankshaft or rod bearings are damaged. To prevent further damage, perform the following steps after the repair:*
- ◆ *Clean the oil channels carefully.*
- ◆ *Replace the oil spray jets.*
- ◆ *Replace the oil cooler.*
- ◆ *Replace the oil filter.*



2 Description and Operation

⇒ "2.1 Overview - Engine Attachments", page 20

⇒ "2.2 Overview - Chain Drive", page 28

⇒ "2.3 Overview - Sealing Flanges and Flywheel/Drive Plate", page 32

⇒ "2.4 Overview - Crankshaft", page 34

⇒ "2.5 Overview - Piston and Connecting Rod", page 35

2.1 Overview - Engine Attachments

BGP, BGQ and BTK

⇒ "2.1.1 Overview - Ribbed Belt", page 20

CBTA, CBUA and CCCA

⇒ "2.1.2 Overview - Ribbed Belt", page 23

⇒ "2.1.3 Overview - Rear Engine", page 25

⇒ "2.1.4 Overview - Engine Front/Side", page 27

2.1.1 Overview - Ribbed Belt

1 - Bolt

- 25 Nm

2 - Bolt

- 25 Nm

3 - Generator

- Removing and installing. Refer to ⇒ Electrical Equipment; Rep. Gr. 27 ; Generator 2.5L Fuel Injection Engine .
- Moving the threaded bushings on the generator slightly to the rear will make it easier to install the generator.

4 - Bolt

- 25 Nm

5 - Bracket with lower relay pulley

- For the A/C compressor ribbed belt
- Do not remove the idler roller.

6 - Bolt

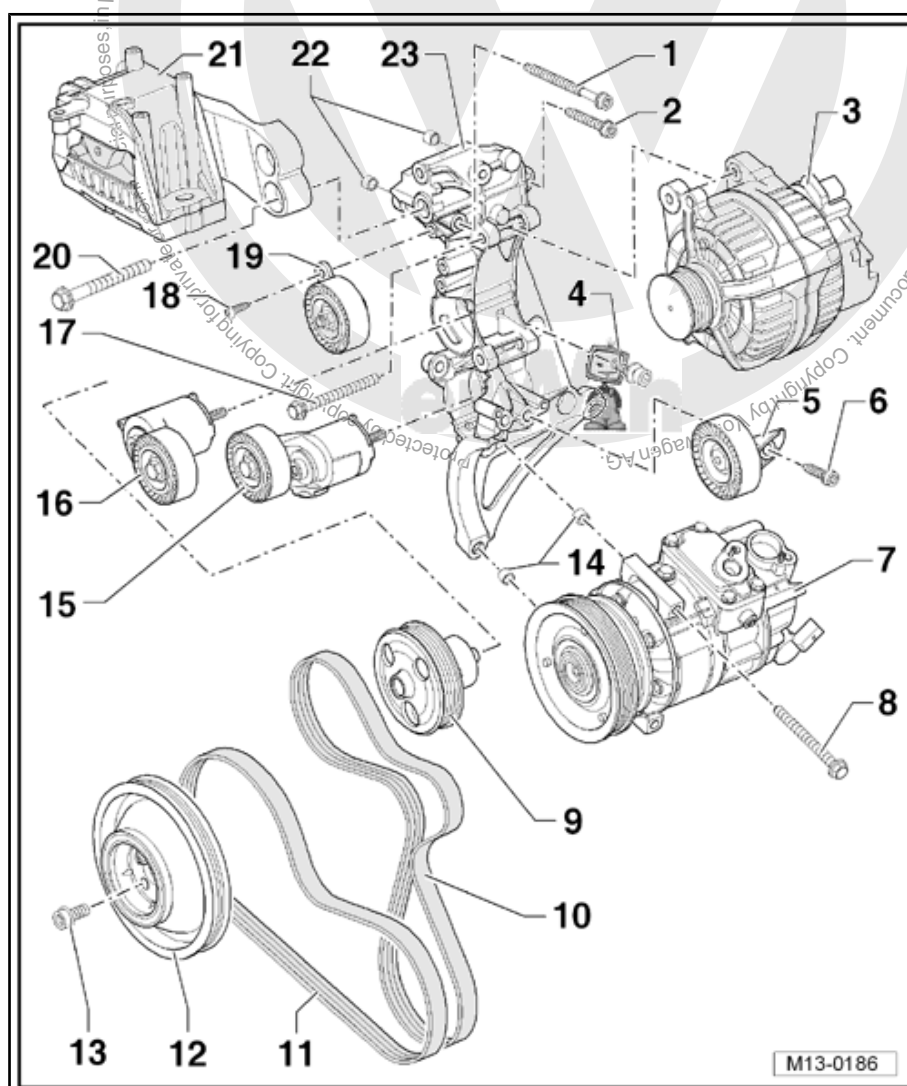
- 25 Nm

7 - A/C Compressor

- Removing and installing. Refer to ⇒ Heating, Ventilation and Air Conditioning; Rep. Gr. 87 .

8 - Bolt

- 25 Nm





9 - Coolant Pump

- ☐ In cylinder block
- ☐ Removing and installing. Refer to ⇒ [“4.2 Coolant Pump”, page 126](#) .

10 - Ribbed Belt for Generator and Coolant Pump

- ☐ Ribbed belt routing. Refer to ⇒ [Fig. ““Ribbed belt routing””, page 22](#)
- ☐ Before removing, mark direction of rotation using chalk or felt-tip marker



Caution

When installing the ribbed belt, make sure it is routed in the right direction and that it is seated correctly on the belt pulleys and the tensioner.

- ☐ Check for wear
- ☐ Do not kink
- ☐ Removing and installing. Refer to ⇒ [“4.1 Ribbed Belt”, page 43](#) .

11 - Ribbed Belt for A/C Compressor

- ☐ Ribbed belt routing. Refer to ⇒ [Fig. ““Ribbed belt routing””, page 22](#)
- ☐ Before removing, mark direction of rotation using chalk or felt-tip marker



Caution

When installing the ribbed belt, make sure it is routed in the right direction and that it is seated correctly on the belt pulleys and the tensioner.

- ☐ Check for wear
- ☐ Do not kink
- ☐ Removing and installing. Refer to ⇒ [“4.1 Ribbed Belt”, page 43](#) .

12 - Belt Pulley/Vibration Damper

- ☐ to remove and install, secure the crankshaft ⇒ [“3.2 Crankshaft, Locking”, page 38](#)

13 - Bolts

- ☐ 50 Nm + 90° (1/4 turn) additional turn
- ☐ Use strength category 10.9 only
- ☐ Quantity: 5
- ☐ Replace

14 - Bushing

- ☐ Quantity: 2

15 - A/C Compressor Ribbed Belt Tensioner

- ☐ 35 Nm
- ☐ Do not remove the tensioning roller.

16 - Generator and Coolant Pump Ribbed Belt Tensioner

- ☐ 35 Nm
- ☐ Do not remove the tensioning roller.

17 - Bolt

- ☐ 25 Nm



18 - Bolt

- ☐ 8 Nm

19 - Bracket with Upper Idler Roller

- ☐ For the ribbed belt for generator and coolant pump
- ☐ Do not remove the idler roller.

20 - Bolt

- ☐ 40 Nm + 90° (1/4 turn) additional turn
- ☐ Replace

21 - Engine Mount

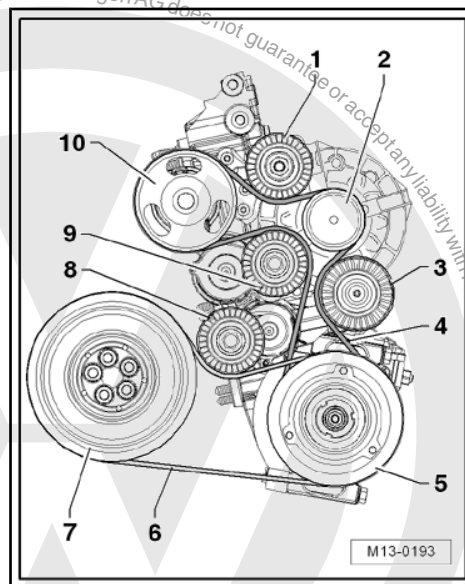
22 - Bushing

- ☐ Quantity: 2

23 - Sub-Assembly Bracket

Ribbed belt routing

- 1 - Upper Idler Roller
- 2 - Belt pulley - generator
- 3 - Lower Idler Roller
- 4 - Ribbed belt for generator and coolant pump
- 5 - Belt pulley - air conditioning compressor
- 6 - Ribbed belt for A/C compressor
- 7 - Belt pulley - crankshaft
- 8 - Tension roller for A/C compressor ribbed belt
- 9 - Tensioning roller for generator and coolant pump ribbed belt
- 10 - Belt pulley - coolant pump





2.1.2 Overview - Ribbed Belt

1 - Bolt

- ☐ 25 Nm

2 - Bolt

- ☐ 25 Nm

3 - Generator

- ☐ Removing and installing. Refer to ⇒ Electrical Equipment; Rep. Gr. 27 ; Generator 2.5L Fuel Injection Engine .
- ☐ Moving the threaded bushings on the generator slightly to the rear will make it easier to install the generator.

4 - Bolt

- ☐ 25 Nm

5 - Bracket with Lower Relay Pulley

- ☐ For the A/C compressor ribbed belt
- ☐ Do not remove the idler roller.

6 - Bolt

- ☐ 25 Nm

7 - A/C Compressor

- ☐ Removing and installing. Refer to ⇒ Heating, Ventilation and Air Conditioning; Rep. Gr. 87 .

8 - Bolt

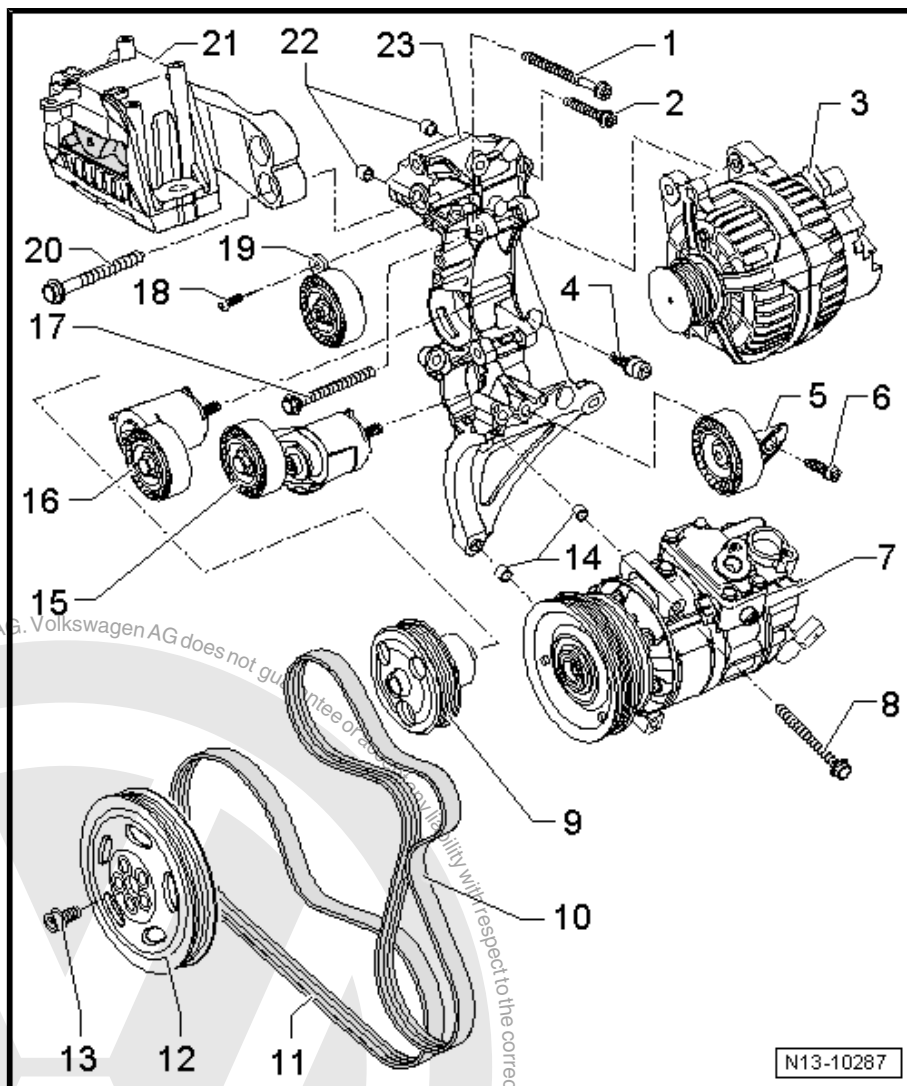
- ☐ 25 Nm

9 - Coolant Pump

- ☐ In cylinder block
- ☐ Removing and installing. Refer to ⇒ ["4.2 Coolant Pump", page 126](#) .

10 - Ribbed Belt for Generator and Coolant Pump

- ☐ Ribbed belt routing. Refer to ⇒ [Fig. "Ribbed belt routing", page 25](#)
- ☐ Before removing, mark direction of rotation using chalk or felt-tip marker



Caution

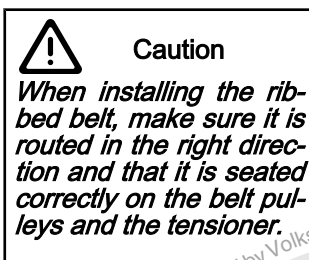
When installing the ribbed belt, make sure it is routed in the right direction and that it is seated correctly on the belt pulleys and the tensioner.

- ☐ Check for wear
- ☐ Do not kink
- ☐ Removing and installing. Refer to ⇒ ["4.1 Ribbed Belt", page 43](#) .



11 - Ribbed Belt for A/C Compressor

- ☐ Ribbed belt routing. Refer to ⇒ [Fig. "Ribbed belt routing", page 25](#)
- ☐ Before removing, mark direction of rotation using chalk or felt-tip marker



- ☐ Check for wear
- ☐ Do not kink
- ☐ Removing and installing. Refer to ⇒ ["4.1 Ribbed Belt", page 43](#)

12 - Belt Pulley/Vibration Damper

- ☐ There are different versions
- ☐ To remove and install, secure the crankshaft. Refer to ⇒ ["3.2 Crankshaft, Locking", page 38](#)

13 - Bolts

- ☐ 50 Nm + 90° (1/4 turn) additional turn
- ☐ Use strength category 10.9 only
- ☐ Quantity: 5
- ☐ Replace

14 - Bushing

- ☐ Quantity: 2

15 - A/C Compressor Ribbed Belt Tensioner

- ☐ 35 Nm
- ☐ Do not remove the tensioning roller.

16 - Generator and coolant pump ribbed belt tensioner

- ☐ 35 Nm
- ☐ Do not remove the tensioning roller.

17 - Bolt

- ☐ 25 Nm

18 - Bolt

- ☐ 8 Nm

19 - Bracket with Upper Idler Roller

- ☐ For the ribbed belt for generator and coolant pump
- ☐ Do not remove the idler roller.

20 - Bolt

- ☐ 40 Nm + 90° (1/4 turn) additional turn
- ☐ Replace

21 - Engine Mount

22 - Bushing

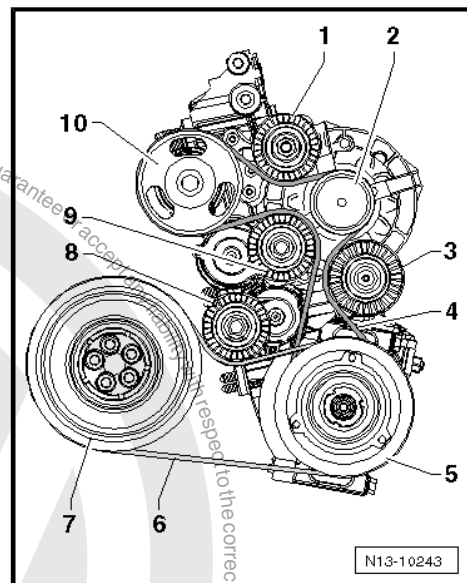
- ☐ Quantity: 2

23 - Sub-assembly bracket



Ribbed belt routing

- 1 - Upper Idler Roller
- 2 - Belt pulley - generator
- 3 - Lower Idler Roller
- 4 - Ribbed belt for generator and coolant pump
- 5 - Belt pulley - air conditioning compressor
- 6 - Ribbed belt for A/C compressor
- 7 - Belt pulley - crankshaft
- 8 - Tension roller for A/C compressor ribbed belt
- 9 - Tensioning roller for generator and coolant pump ribbed belt
- 10 - Belt pulley - coolant pump



2.1.3 Overview - Rear Engine

1 - Cylinder Block

2 - Sealing Plug

- ☐ 30 Nm
- ☐ With rolled up seal
- ☐ Bore in cylinder block for securing crankshaft with Crankshaft Locking Pin - T40069- .

3 - Knock Sensor 1 - G61-

- ☐ Pay attention to the installed position: the cable connection faces downward

4 - Bolt

- ☐ 20 Nm
- ☐ Tightening specifications affects function of Knock Sensor (KS).

5 - Bolt

- ☐ 10 Nm

6 - Cover Plate

7 - Bayonet Connection

8 - Cable Clamp

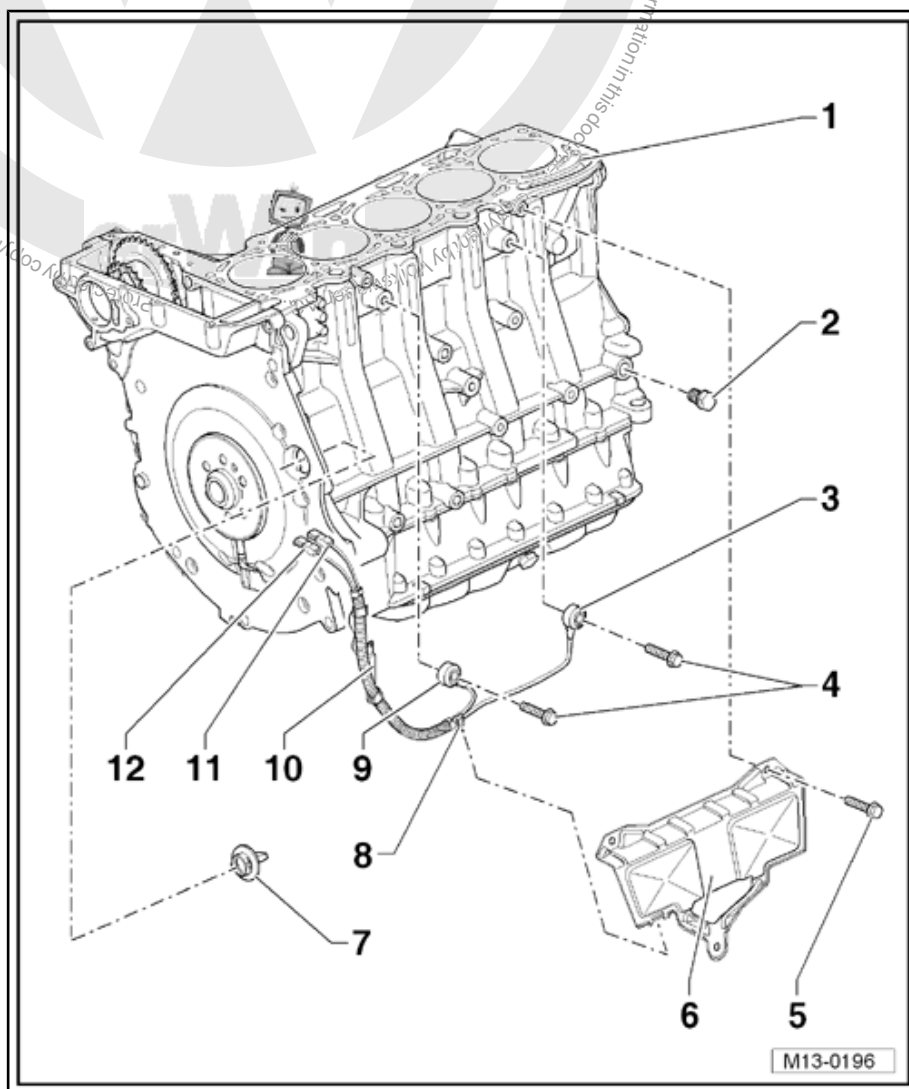
- ☐ Clamped on cover plate

9 - Knock Sensor 2 - G66-

- ☐ Pay attention to the installed position: the cable connect faces outward 45° to the right

10 - Wiring Bracket

- ☐ Bolted to secondary air injection solenoid valve





11 - Connector

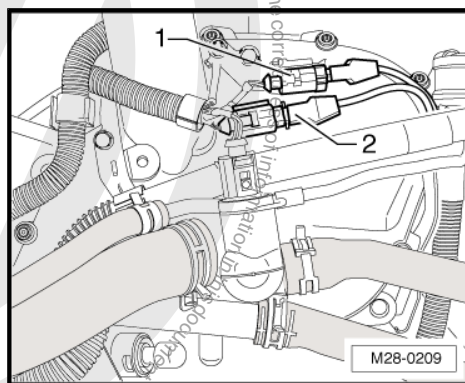
- ☐ Green for Knock Sensor 1 - G61-
- ☐ Installed position. Refer to
⇒ Fig. [“Installation position of harness connectors for knock sensors”](#), page 26
- ☐ Contacts gold plated

12 - Connector

- ☐ Gray for Knock Sensor 2 - G66-
- ☐ Installed position. Refer to
⇒ Fig. [“Installation position of harness connectors for knock sensors”](#), page 26
- ☐ Contacts gold plated

Installation position of harness connectors for knock sensors

- 1 - Green for Knock Sensor 1 - G61-
- 2 - Gray for Knock Sensor 2 - G66-





2.1.4 Overview - Engine Front/Side

1 - Cylinder Block

2 - Seal

- ☐ Replace

3 - Brake Booster Vacuum Pump

- ☐ Do not open
- ☐ Removing and installing. Refer to
 ⇒ ["4.2 Brake Booster Vacuum Pump", page 44](#) .

4 - Mount

5 - Bolt

- ☐ 10 Nm

6 - Oil Filter Bracket with Attachments

- ☐ Overview. Refer to
 ⇒ ["2.2 Overview - Oil Filter Bracket with Attachments", page 94](#) .

7 - Bolt

- ☐ 25 Nm

8 - Bolt

- ☐ 10 Nm

9 - Bolt

- ☐ 10 Nm

10 - Thermostat Housing

- ☐ With thermostat and coolant pipe

11 - Bolt

- ☐ 10 Nm

12 - Intake Manifold Support

- ☐ Only for engines with the secondary air injection system

13 - Bolt

- ☐ 25 Nm

14 - Bolt

- ☐ 10 Nm

15 - Bolt

- ☐ 25 Nm

16 - Sub-Assembly Bracket

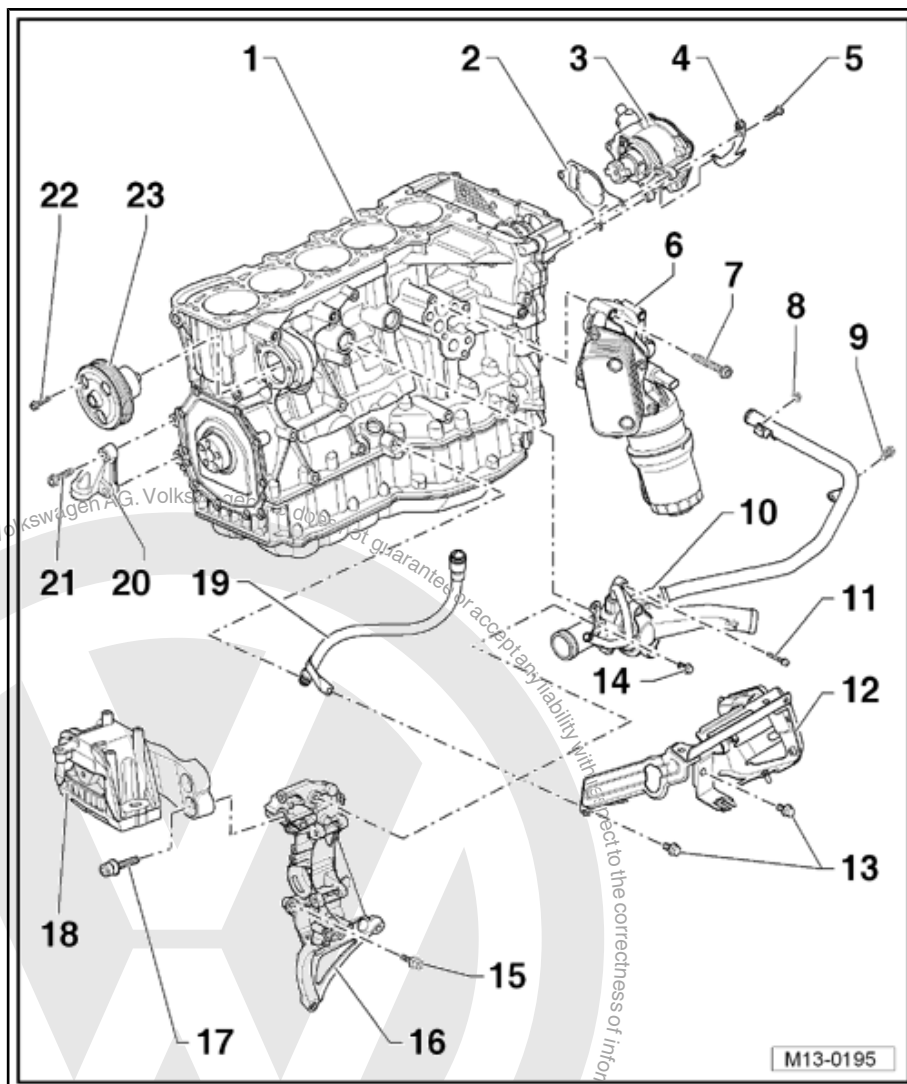
17 - Bolt

- ☐ 40 Nm + 90° (1/4 turn) additional turn
- ☐ Replace

18 - Engine Mount

19 - Guide Tube

- ☐ For the oil dipstick





20 - Transport Strap

- ☐ Not needed for service.

21 - Bolt

- ☐ 25 Nm

22 - Bolt

- ☐ 10 Nm

23 - Coolant Pump

- ☐ With integrated silicone sealing ring for the cylinder block seal
- ☐ Removing and installing. Refer to ⇒ [“4.2 Coolant Pump”, page 126](#) .

2.2 Overview - Chain Drive

⇒ [“2.2.1 Chain Drive Assembly”, page 28](#)

⇒ [“2.2.2 Overview - Chain Drive”, page 29](#)

⇒ [“2.2.3 Overview - Timing chain”, page 30](#)

⇒ [“2.2.4 Overview - Power Take-Off Drive Chain”, page 31](#)

2.2.1 Chain Drive Assembly

I - Overview

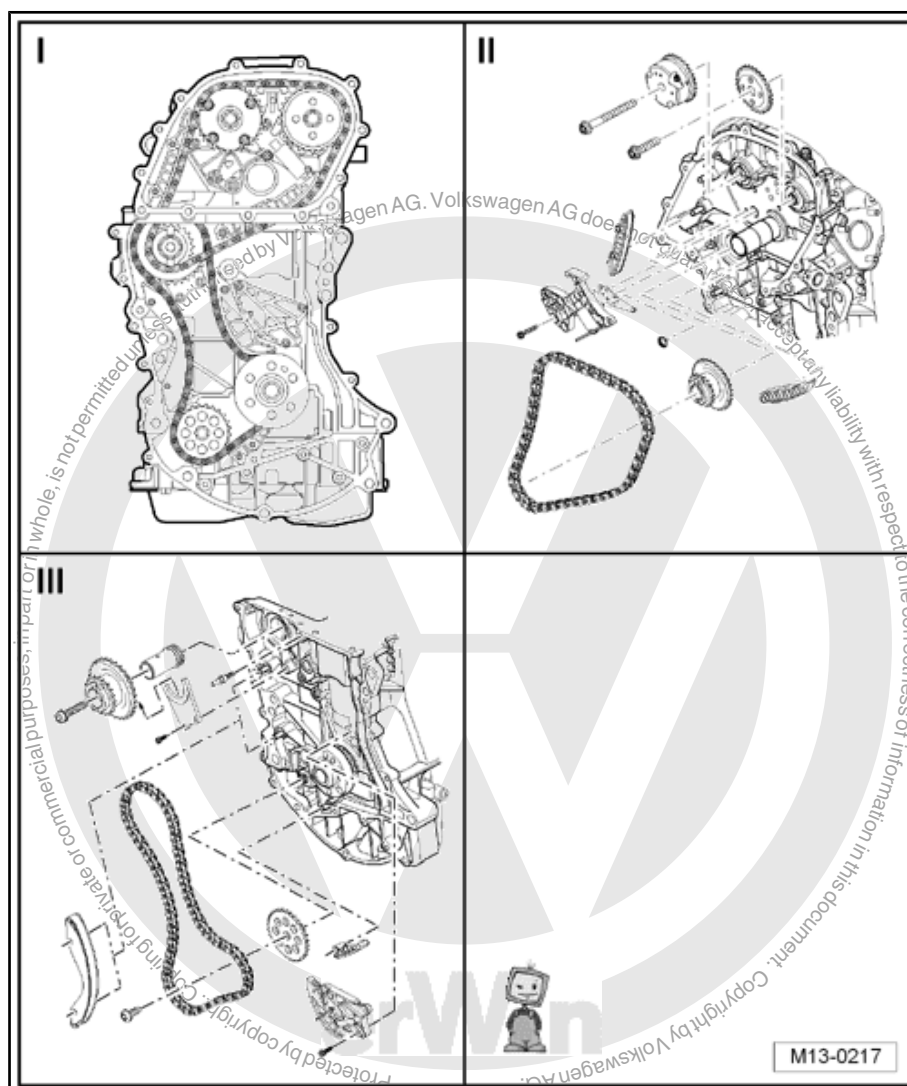
⇒ [“2.2.2 Overview - Chain Drive”, page 29](#)

II - Timing chain

⇒ [“2.2.3 Overview - Timing chain”, page 30](#)

III - Drive chain for timing mechanism

⇒ [“2.2.4 Overview - Power Take-Off Drive Chain”, page 31](#)





2.2.2 Overview - Chain Drive

1 - Chain Sprocket for Exhaust Camshaft

2 - Chain Tensioner for Timing Chain

- ☐ At top with sliding insert

3 - Timing Chain

4 - Tensioning Rail

- ☐ For timing chain tensioner
- ☐ Secured on cylinder block

5 - Chain Tensioner for Drive Chain

- ☐ With tensioning track

6 - Chain Sprocket of Crankshaft

- ☐ Component of crankshaft

7 - Guide Rail for Drive Chain

- ☐ Secured on upper section of oil pan

8 - Chain Sprocket of Oil Pump

- ☐ Removing and installing

- ◆ Engine codes BGP, BGQ and BTK. Refer to ["4.4 Oil Pump", page 103](#).

- ◆ Engine codes CBTA, CBUA and CCCA. Refer to ["4.5 Oil Pump", page 106](#).

9 - Guide Rail for Drive Chain

10 - Power Take-Off Drive Chain

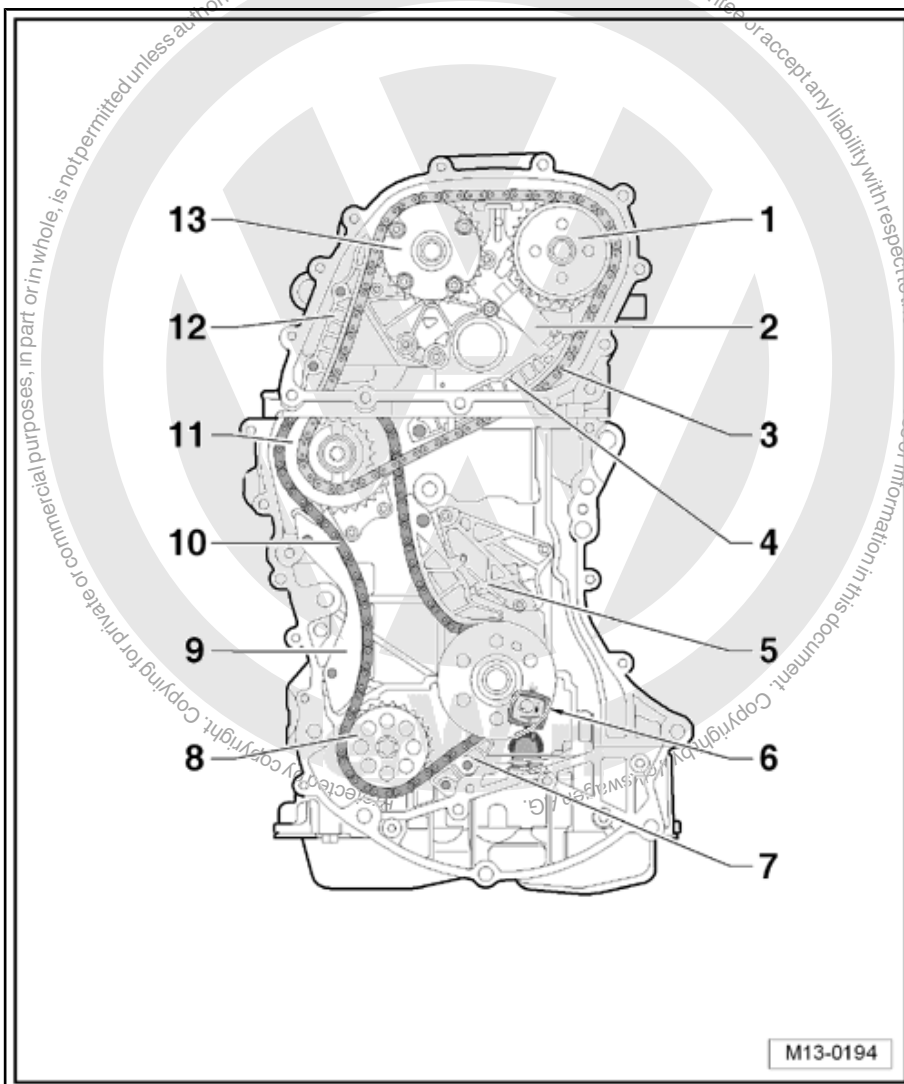
- ☐ From MY 2008 the roller chain has been changed to a toothed chain.

11 - Double Chain Sprocket (Drive Wheel)

12 - Glide Track for Timing Chain

13 - Cam Shaft Adjuster for Intake Camshaft

- ☐ With chain sprocket





2.2.3 Overview - Timing chain

1 - Cam Shaft Adjuster for In-take Camshaft

- ☐ With chain sprocket
- ☐ Do not disassemble

2 - Chain Sprocket for Exhaust Camshaft

- ☐ Not pressed on the camshaft
- ☐ When removing, press off lightly if necessary

3 - Cylinder Head

4 - Tensioning Rail

- ☐ For timing chain tensioner
- ☐ Secured on cylinder block
- ☐ Oil pin before installing

5 - Double Chain Sprocket (Drive Wheel)

- ☐ Securing
⇒ ["2.2.4 Overview - Power Take-Off Drive Chain", page 31](#)

6 - Timing Chain

- ☐ Removing:
 - Work procedure as for "Adjust valve timing". Refer to
⇒ ["3.2 Valve Timing, Adjusting", page 64](#) .
 - Vacuum pump, removing
⇒ ["4.2 Brake Booster Vacuum Pump", page 44](#) .
- Mark the direction of travel.
- ☐ Note when installing:
 - Install in original direction of rotation.
 - Chain must lie correctly in tensioning and glide tracks.
 - Adjust the valve timing. Refer to ⇒ ["3.2 Valve Timing, Adjusting", page 64](#) .

7 - Strainer

- ☐ Replace

8 - Bolt

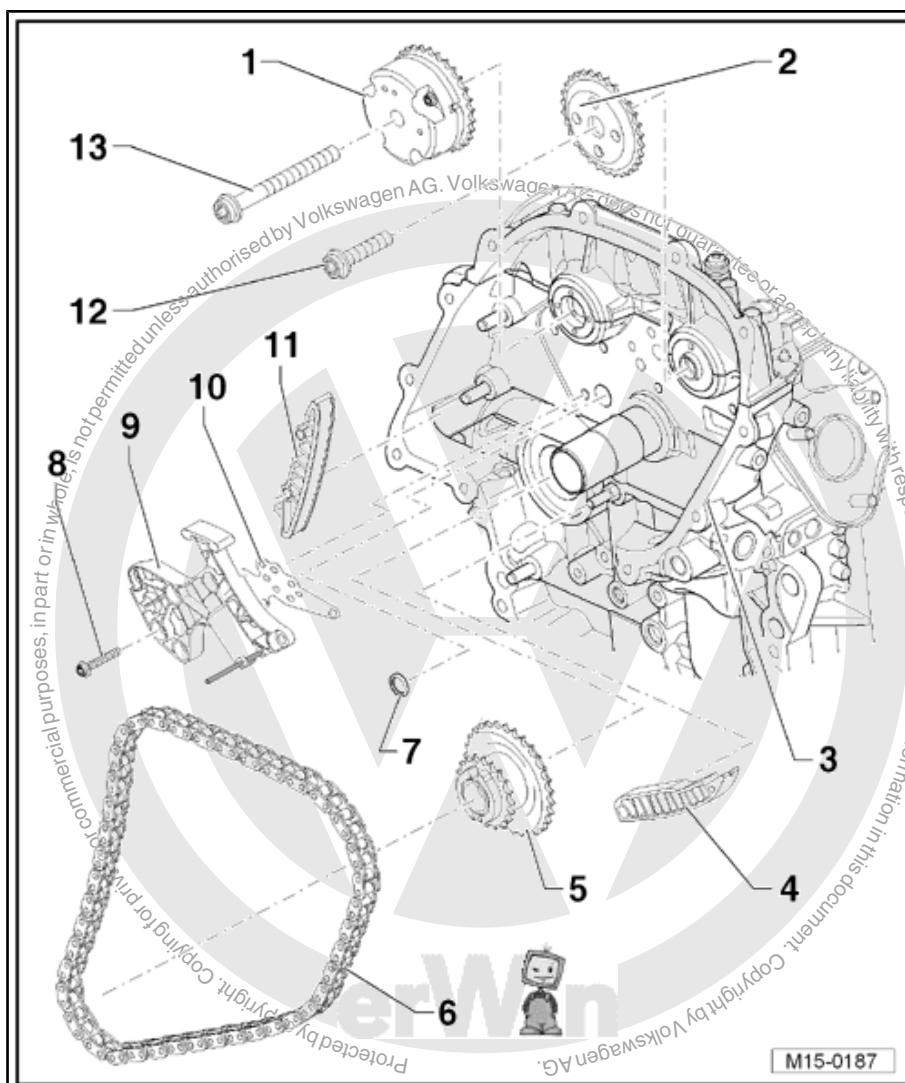
- ☐ 10 Nm

9 - Chain Tensioner

- ☐ Secure with Locking Pins - T03006-

10 - Seal

- ☐ Replace





11 - Guide Rail

- ☐ Oil pin before installing

12 - Bolt

- ☐ 60 Nm + 90° (1/4 turn) additional turn
- ☐ Replace

13 - Bolt

- ☐ 60 Nm + 90° (1/4 turn) additional turn
- ☐ Replace

2.2.4 Overview - Power Take-Off Drive Chain

1 - Cylinder Block

2 - Guide Rail

- ☐ Secured on upper section of oil pan
- ☐ Oil pin before installing

3 - Chain Tensioner

- ☐ Secure with Locking Pin - T10115-

4 - Bolt

- ☐ 10 Nm

5 - Chain Sprocket of Oil Pump

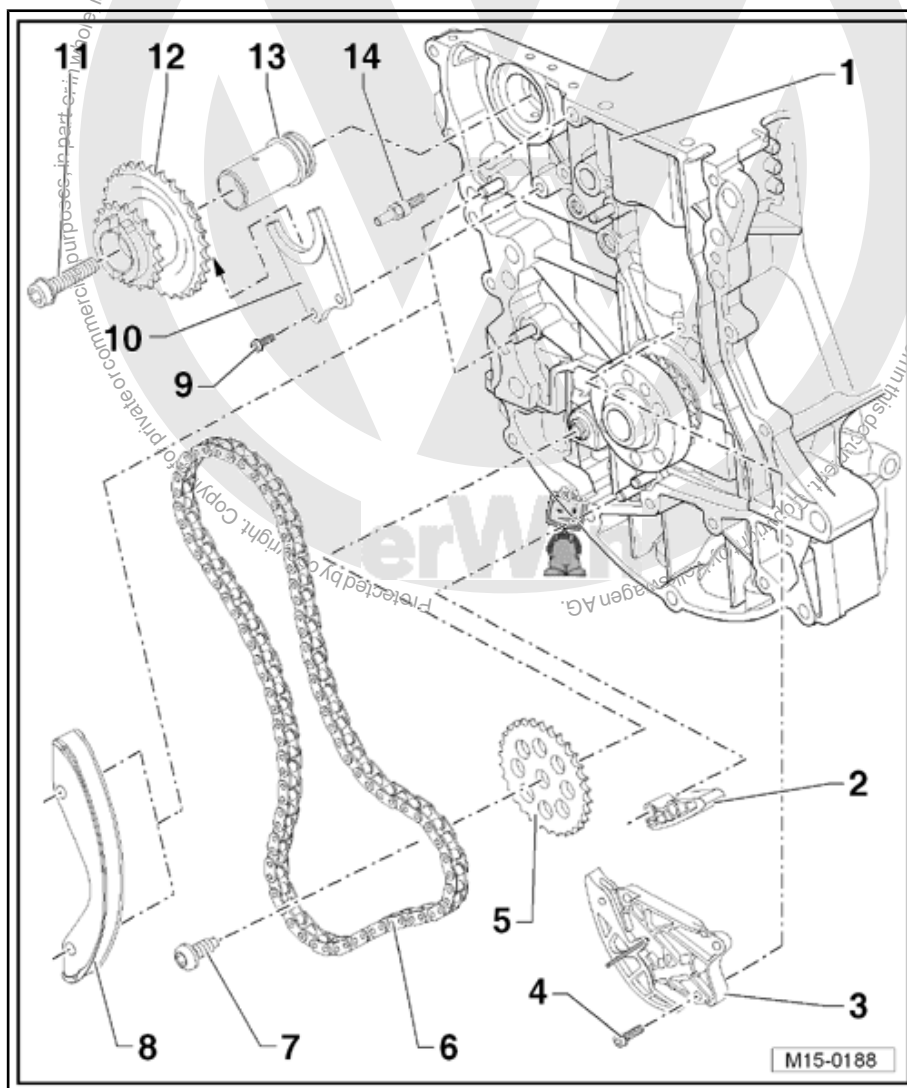
- ☐ Removing and installing

- ◆ Engine codes BGP, BGQ and BTK. Refer to ["4.4 Oil Pump", page 103](#).

- ◆ Engine codes CBTA, CBUA and CCCA. Refer to ["4.5 Oil Pump", page 106](#).

6 - Power Take-Off Drive Chain

- ☐ From MY 2008 the roller chain has been changed to a toothed chain.
- ☐ Removing:
 - Remove engine.
 - Remove control housing cover.
 - Remove timing chain.
 - Remove chain tensioner -item 3- ➤ [Item 3 \(page 31\)](#).
 - Mark the direction of travel.
- ☐ Note when installing:
 - Install in original direction of rotation.
 - Chain must lie correctly in tensioning and glide tracks.





- Adjust the valve timing. Refer to ⇒ ["3.2 Valve Timing, Adjusting", page 64](#) .

7 - Bolt

- ☐ 20 Nm + 90° (1/4) additional turn
- ☐ Replace

8 - Guide Rail

- ☐ Oil pin before installing

9 - Bolt

- ☐ 10 Nm

10 - Axial bearing disc

- ☐ Engages in groove of double chain sprocket (drive wheel) -item 12- ⇒ [Item 12 \(page 32\)](#) .

11 - Bolt

- ☐ 60 Nm + 90° (1/4 turn) additional turn
- ☐ Replace

12 - Double Chain Sprocket (Drive Wheel)

- ☐ Oil the journal before installing
- ☐ Oil groove for axial bearing disc -item 10- ⇒ [Item 10 \(page 32\)](#)

13 - Journal For Double Chain Sprocket (Drive Wheel)

14 - Tensioning Track Pin

- ☐ 40 Nm
- ☐ For timing chain tensioner

2.3 Overview - Sealing Flanges and Fly-wheel/Drive Plate



Note

Servicing the clutch

. Refer to ⇒ *Manual Transmission; Rep. Gr. 30 ; Clutch, Servicing* .



1 - Belt Pulley/Vibration Damper

- ☐ There are different versions

2 - Bolts

- ☐ 50 Nm + 90° (1/4 turn) additional turn
- ☐ Quantity: 5
- ☐ Replace
- ☐ Use strength category 10.9 only

3 - Bolt

- ☐ 10 Nm

4 - Sealing Flange on Belt Pulley Side

- ☐ With integrated sealing ring
- ☐ Removing and installing. Refer to ➤ ["4.3 Crankshaft Sealing Flange, Belt Pulley Side", page 46](#) .

5 - Cylinder Block

6 - Bolt

- ☐ 60 Nm + 90° (1/4 turn) additional turn
- ☐ Replace

7 - Drive Plate/Flywheel

- ◆ To remove, secure crankshaft using the Crankshaft Locking Pin - T40069- .

- ◆ Flywheel must not be pried out or timing housing cover will be damaged

- ☐ Drive Plate, Removing and Installing. Refer to ➤ ["4.6 Drive Plate", page 53](#) .

8 - Sensor Wheel

- ☐ For Engine Speed Sensor - G28-
- ☐ With position holder

9 - Seal -Transmission Side-

- ☐ Removing and installing. Refer to ➤ ["4.5 Sealing Ring on Transmission Side", page 52](#) .

10 - Control Housing Cover

- ☐ Removing and installing. Refer to ➤ ["4.4 Control Housing Cover", page 49](#) .

11 - O-Ring

- ☐ Replace

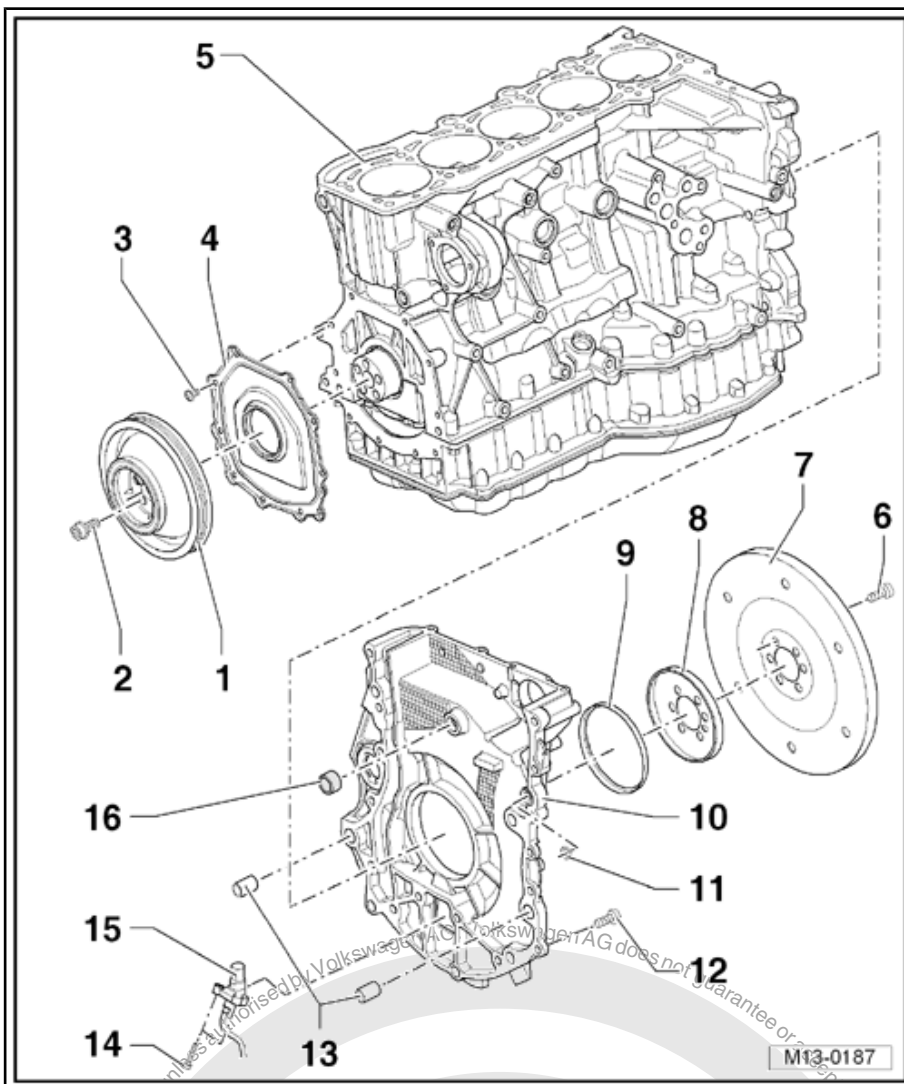
12 - Bolt

- ☐ 25 Nm

13 - Alignment Sleeves

14 - Bolt

- ☐ 5 Nm





15 - Engine Speed Sensor - G28

16 - Seal

- ☐ Replace

2.4 Overview - Crankshaft



Note

Engine is to be secured
to the Engine And Transmission Holder - Engine Lateral Bracket
- T03001- for performing assembly work.

1 - Bolt

- ☐ 40 Nm + 90° (1/4 turn)
additional turn
- ☐ Tighten to 40 Nm to
measure the radial play
in the crankshaft. Do not
tighten any further.
- ☐ Replace
- ☐ Fully threaded

2 - Bearing Cap

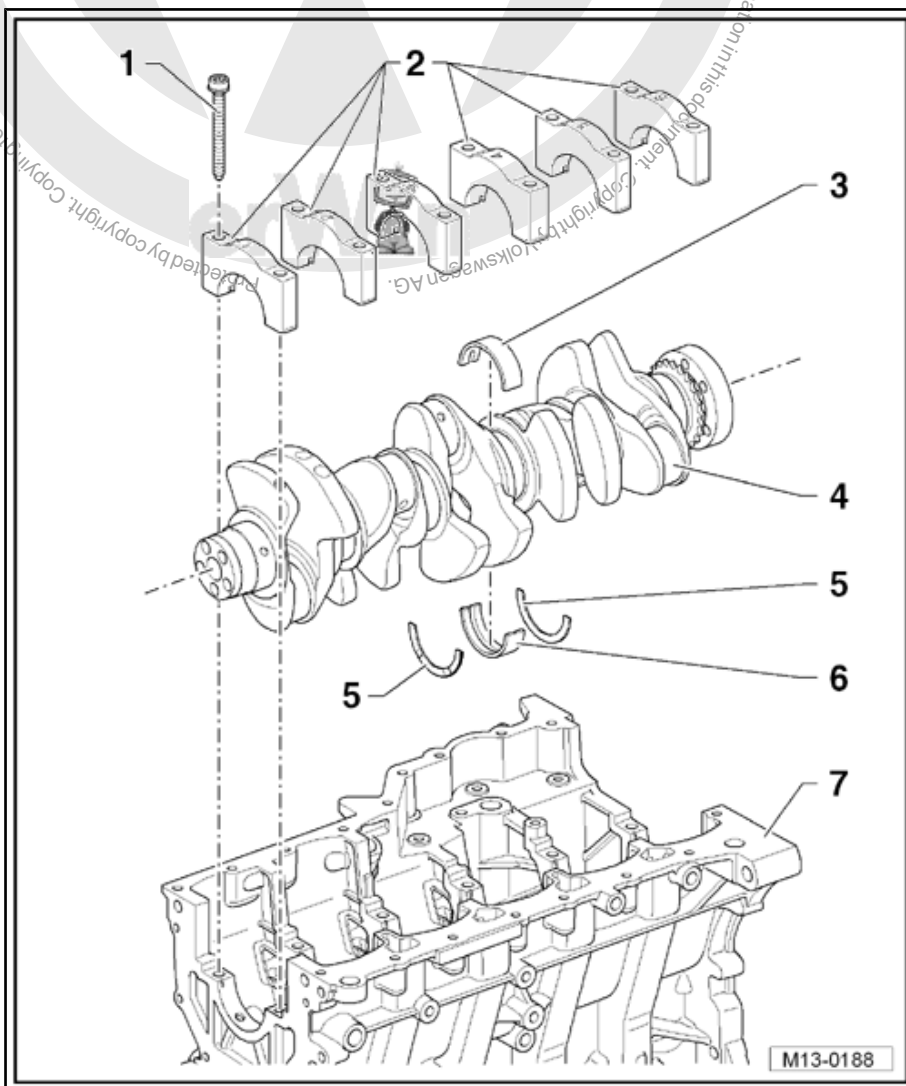
- ☐ Bearing cap 1: belt pul-
ley side
- ☐ Retaining tabs of bear-
ing shells and cylinder
block/bearing caps
must lie above one an-
other

3 - Bearing Shell for Bearing Cap

- ☐ Without lubricating
groove
- ☐ Do not interchange
used bearing shells
(mark)

4 - Crankshaft

- ☐ Axial play new: 0.07 to
0.21 mm
Wear limit: 0.30 mm
- ☐ Measure the radial
clearance with a Plasti-
gage®.
New: 0.023 to 0.043 mm
wear limit: 0.07 mm



- ☐ Do not turn crankshaft when measuring radial play
- ☐ Crankshaft Dimensions. Refer to ⇒ [“3.1 Crankshaft Dimensions”, page 38](#) .
- ☐ Secure the crankshaft. Refer to ⇒ [“3.2 Crankshaft, Locking”, page 38](#)

5 - Thrust Washers

- ☐ For bearing 3
- ☐ Side lubricating grooves face outward



6 - Bearing Shell for Cylinder Block

- ☐ With lubricating groove
- ☐ Classification for replacement part ordering. Refer to
⇒ Fig. ““Identification of the upper crankshaft bearing shells””, page 35
- ☐ Do not interchange used bearing shells (mark)

7 - Cylinder Block

Identification of the upper crankshaft bearing shells

From the factory, the upper bearing shells are allocated to the cylinder block with the correct thickness. Colored spots serve to identify the bearing thicknesses.

The letters marked on the lower sealing surface of the cylinder block identify which bearing thickness must be installed in which location.

G - yellow

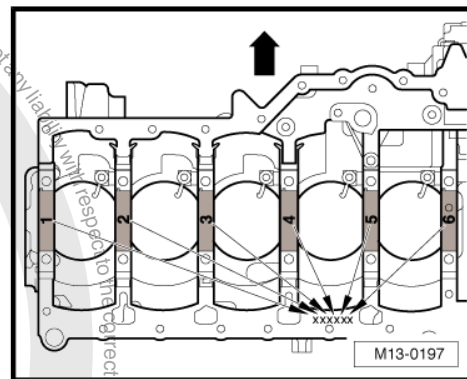
B - Blue

W - white



Note

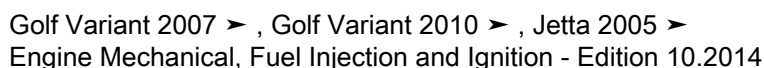
- ◆ The -arrow- points in the direction of travel.
- ◆ If the color markings are not legible, use the blue bearing shell.
- ◆ The lower crankshaft bearing shells are always shipped as replacement part with “yellow” color marking.



2.5 Overview - Piston and Connecting Rod

Piston and Connecting Rod





- ☐ 30 Nm + 90° (1/4 additional turn)
- ☐ Replace
- ☐ Lubricate threads and contact surface
- ☐ Tighten to 30 Nm for measuring radial clearance, but do not tighten further.

- ❑ 27 Nm
- ❑ Opening pressure: 1.3 to 1.6 bar

- For piston cooling

- ☐ Note the installation position
- ☐ Due to the separation procedure (cracking) of the connecting rod, the cap only fits in one position and only to the corresponding connecting rod.
- ☐ Mark which cylinder to which it belongs -B-.
- ☐ Installed position: markings -A- face the pulley side



- ☐ Note the installation position. Refer to [⇒ Fig. ““Bearing shells installed position””, page 37](#).
- ☐ Do not interchange used bearing shells.
- ☐ New axial play: 0.10 to 0.35 mm

Wear limit: 0.4 mm

- ❑ Measure radial clearance with Plastigage®:

New: 0.02 to 0.06 mm

Wear limit: 0.09 mm.

Do not turn crankshaft when measuring radial play.

- ❑ With cracked bearing cap
- ❑ New connecting rod, separating ⇒ [“5.1 New Connecting Rod, Separating”, page 55](#).
- ❑ Always replace as a set.
- ❑ Mark which cylinder to which it belongs -B-.
- ❑ Installed position: markings -A- face the pulley side

8 - Piston Pin

- ☐ If difficult to move, heat piston to 60 °C (140 °F)
- ☐ Remove and install using the Pilot Drift - VW222 A-



9 - Piston

- ☐ Checking. Refer to ➤ Fig. [“Pistons, Checking”](#), page 41 .
- ☐ Mark installed position and cylinder allocation
- ☐ Arrow on piston face points toward belt pulley side
- ☐ Install with piston ring compressor
- ☐ Checking the cylinder bore. Refer to ➤ Fig. [“Cylinder Bore, Checking”](#), page 42 .
- ☐ Piston and Cylinder Dimensions. Refer to ➤ [“3.4 Piston and Cylinder Dimensions”](#), page 42 .

10 - Piston Rings

- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers for removing and installing
- ☐ Markings face toward piston crown
- ☐ Checking the ring gap. Refer to ➤ Fig. [“Checking the piston ring gap”](#), page 41 .
- ☐ Checking the piston ring groove clearance. Refer to ➤ Fig. [“Piston Ring Groove Clearance, Checking”](#), page 41 .

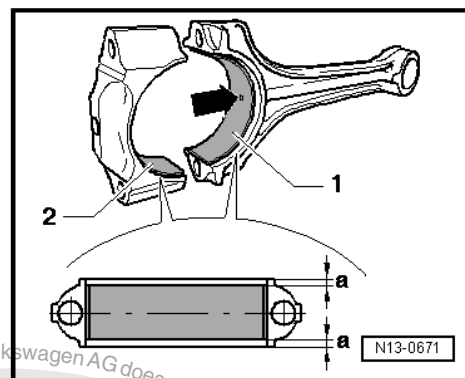
Bearing shells installed position

Bearing shell -1- with oil bore -arrow- for connecting rod.

Bearing shell -2- without oil bore for connecting rod cover.

- Place the bearing shells centrally into the connecting rod and connecting rod cap.

Dimension -a- must be the same at left and right.





3 Diagnosis and Testing

⇒ [“3.1 Crankshaft Dimensions”, page 38](#)

⇒ [“3.2 Crankshaft, Locking”, page 38](#)

⇒ [“3.3 Piston, Pistons Rings and Cylinder Bore, Checking”, page 41](#)

⇒ [“3.4 Piston and Cylinder Dimensions”, page 42](#)

3.1 Crankshaft Dimensions

(Dimensions in mm)

Honing dimension	Crankshaft bearing pin diameter		Connecting rod bearing pin diameter	
Standard dimension	58.00	-0.022 -0.042	47.80	-0.022 -0.042
1st oversize	57.75	-0.022 -0.042	47.55	-0.022 -0.042
2nd oversize	57.50	-0.022 -0.042	47.30	-0.022 -0.042
Stage III	57.25	-0.022 -0.042	47.05	-0.022 -0.042

3.2 Crankshaft, Locking

Special tools and workshop equipment required

- ♦ Torque Wrench 1331 5-50Nm - VAG1331
- ♦ Crankshaft Adapter - T03003-
- ♦ Crankshaft Locking Pin - T40069-

Securing the crankshaft for valve timing inspection/adjustment.
Refer to ⇒ [page 39](#) .

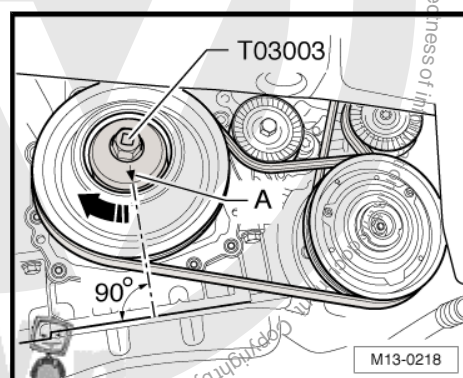
Procedure

- Remove the noise insulation. Refer to ⇒ Body Exterior; Rep. Gr. 50 ; Noise Insulation .
- Remove the front section of the right front wheel housing liner. Refer to ⇒ Body Exterior; Rep. Gr. 66 ; Wheel Housing Liner .
- Attach the Crankshaft Adapter - T03003- on to belt pulley bolts.

The Crankshaft Adapter - T03003- can only be inserted correctly in one position.

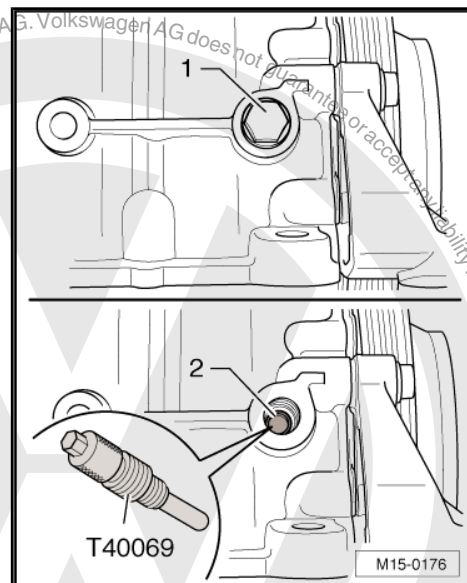
- Rotate the crankshaft in direction of engine rotation -arrow- far enough until arrow -A- on Crankshaft Adapter - T03003- points downward vertically, relative to the engine axis.

This position corresponds approximately to TDC position of crankshaft at cylinder 5.





- Remove the sealing plug -1- from the back of the cylinder block.
- Look through the threaded hole to see if the hole -2- in the crankshaft lines up with the threaded hole.
 Use a mirror to do so.
- Rotate the crankshaft slightly if necessary.
- If the holes align, install the Crankshaft Locking Pin - T40069- completely into threaded hole and tighten it to 10 Nm.

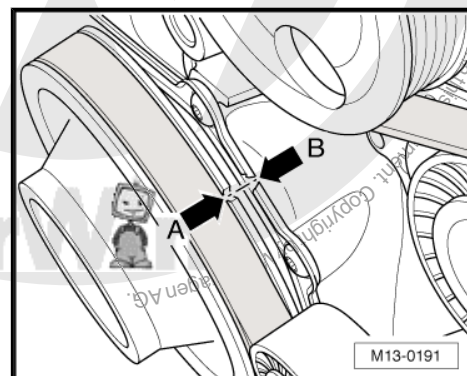


Note

With engine removed, TDC marking can also be seen on belt pulley and sealing flange on belt pulley side. Notches -A- and -B- must align.

- Check whether the crankshaft can be rotated.

After assembly work:



- Remove the Crankshaft Locking Pin - T40069- and install the sealing plug -1- on cylinder block in the rear.

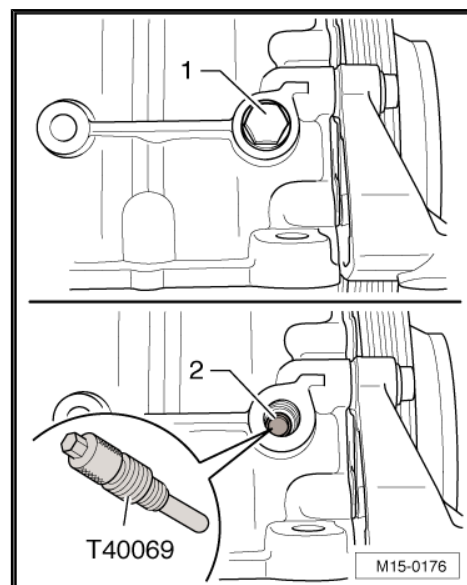
The rest of the installation follows the reverse of the removal procedures.

Tightening Specification:

Component	Nm
Sealing plug to cylinder block at rear	30 Nm

Crankshaft, Locking to Check/Adjust Valve Timing

- Remove the cylinder head cover. Refer to ➤ [“4.1 Cylinder Head Cover”, page 70](#) .
- Perform the steps for “Securing crankshaft”. Refer to ➤ [“3.2 Crankshaft, Locking”, page 38](#) .





Note

If threaded holes in camshafts -arrows- do not stand upward, crankshaft must be rotated one rotation (360°) in direction of engine rotation.

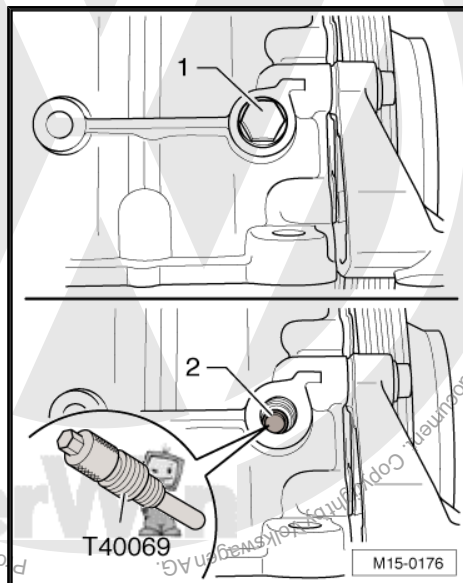
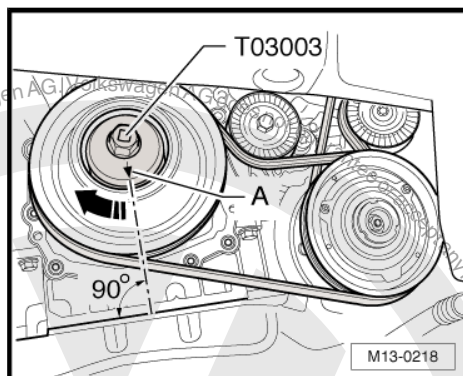
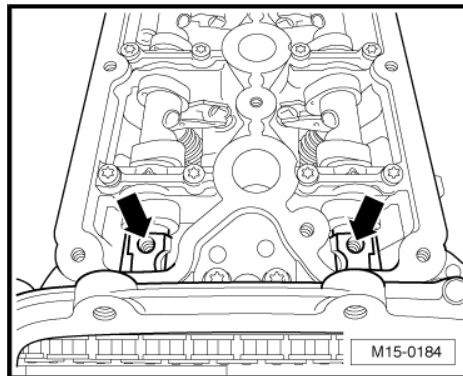
In order to be able to precisely check and adjust valve timing, always note the following:

- ◆ Only turn crankshaft only in direction of engine rotation -arrow-. Do not rotate crankshaft back, not even slightly!
- ◆ Crankshaft must not be rotated out over the TDC marking. This means bore -2- in crankshaft must not stand above threaded opening.

If crankshaft was rotated out over the TDC marking:

- Then rotate the crankshaft again into TDC position in the direction of engine rotation.

When the crankshaft is positioned slightly in front of the TDC position (hole in crankshaft is 90 % visible), the Crankshaft Locking Pin - T40069- can be screwed in, although slightly more difficult.





3.3 Piston, Pistons Rings and Cylinder Bore, Checking

Special tools and workshop equipment required

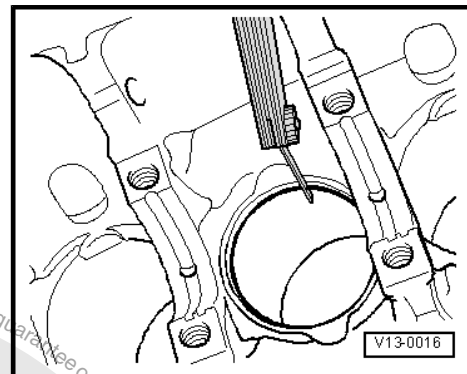
- ◆ Feeler Gauge

Checking the piston ring gap

- Insert the piston ring into the lower cylinder opening at a right angle from above approximately 15 mm from the cylinder edge.

To do this use a piston without piston rings.

Piston Ring		Gap	
		New	Wear limit
Compression rings	mm	0.20 to 0.40	0.8
Oil scraping ring	mm	0.25 to 0.50	0.8



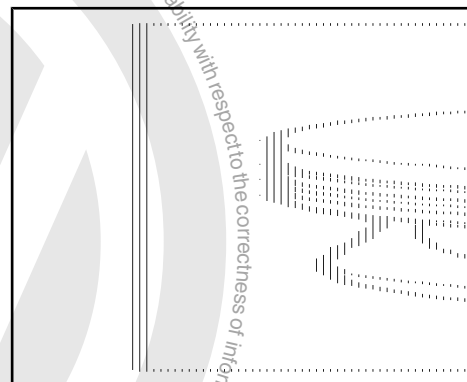
Piston Ring Groove Clearance, Checking

Special tools and workshop equipment required

- ◆ Feeler Gauge

- Clean the groove in the ring before checking.

Piston Ring		Ring to groove clearance	
		New	Wear limit
Compression rings	mm	0.06 to 0.09	0.20
Oil scraping ring	mm	0.03 to 0.06	0.15

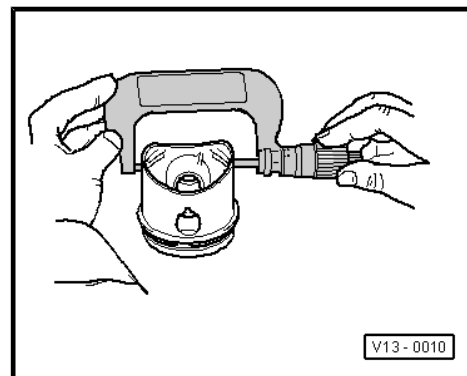


Pistons, Checking

Special tools and workshop equipment required

- ◆ External micrometer 75 to 100 mm

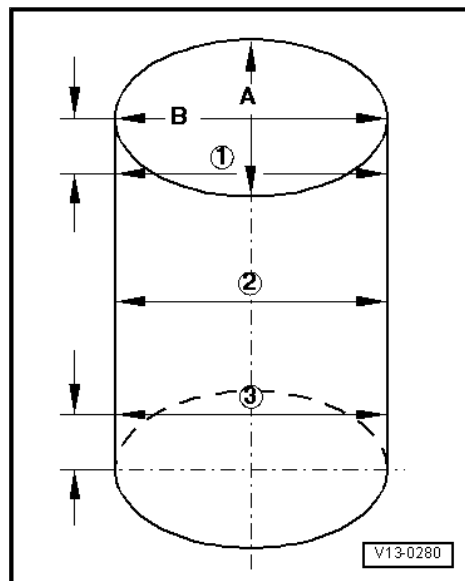
- Take measurement approximately 10 mm from lower edge of piston skirt and offset 90° to piston axis.





Deviations from the specified size: maximum 0.04 mm

Cylinder Bore, Checking



Special tools and workshop equipment required

- ◆ Internal dial gauge 50 to 100 mm
- Measure diagonally at three positions transversely -A- and longitudinally -B-.

Deviation from nominal size: max. 0.08 mm.



Note

Cylinder bore must not be measured if cylinder block is secured to engine stand with Engine And Transmission Holder - Engine Lateral Bracket - T03001- , or else results may be incorrect.

3.4 Piston and Cylinder Dimensions

Honing dimension		Piston diameter	Cylinder bore diameter
Standard dimension	mm	82.465 ⁷⁾	82.51

7) Measurement does not include graphite coating (thickness = 0.02 mm). The graphite coating wears off.



4 Removal and Installation

⇒ ["4.1 Ribbed Belt", page 43](#)

⇒ ["4.2 Brake Booster Vacuum Pump", page 44](#)

⇒ ["4.3 Crankshaft Sealing Flange, Belt Pulley Side", page 46](#)

⇒ ["4.4 Control Housing Cover", page 49](#)

⇒ ["4.5 Sealing Ring on Transmission Side", page 52](#)

⇒ ["4.6 Drive Plate", page 53](#)

4.1 Ribbed Belt

⇒ ["4.1.1 Ribbed Belt", page 43](#)

4.1.1 Ribbed Belt

Special tools and workshop equipment required

- ◆ Locking Pin - T10060A-

Ribbed belt, removing

- Remove the noise insulation. Refer to ⇒ Body Exterior; Rep. Gr. 50 ; Noise Insulation.
- Remove the front section of the right front wheel housing liner. Refer to ⇒ Body Exterior; Rep. Gr. 66 ; Wheel Housing Liner .

Remove the A/C compressor ribbed belt



Caution

Risk of damage due to reversed running direction on a used ribbed belt.

- ◆ ***Before removing ribbed belt, marking running direction with chalk or felt-tip pen for reinstallation later.***

- Swivel tensioning element -1- as illustrated using a 15 mm open end wrench -A- in direction of -arrow- and secure using the Locking Pin - T10060A- .
- Remove ribbed belt for A/C compressor.

Remove ribbed belt for generator and coolant pump.

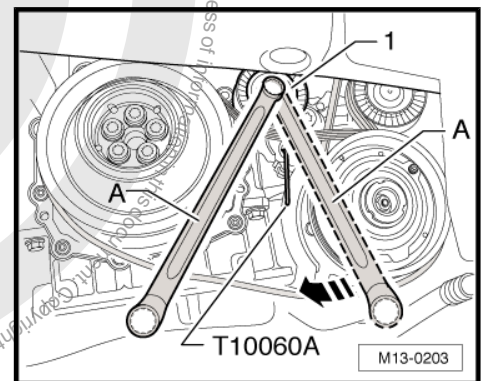


Caution

Risk of damage due to reversed running direction on a used ribbed belt.

- ◆ ***Before removing ribbed belt, marking running direction with chalk or felt-tip pen for reinstallation later.***

- Relieve the tensioning element -1- for A/C compressor ribbed belt of tension (pull out Locking Pin - T10060A-).





- Insert the Locking Pin - T10060A- into the tensioner -2-.
- Swivel the tensioner -2- in direction of -arrow- using a 15 mm wrench -A- and then lock it into place with Locking Pin - T10060A- .
- Remove ribbed belt for generator and coolant pump.

Ribbed belt, installing

Install in reverse order of removal while noting the following:

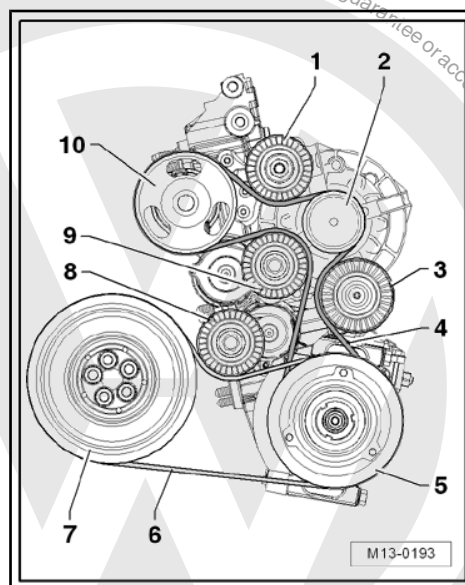
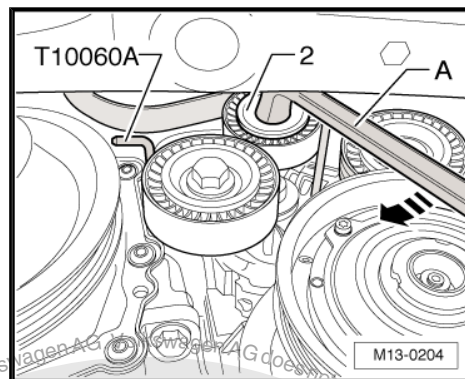
- Place ribbed belt for generator and coolant pump on to belt pulleys, then lastly on to idler pulley -3-.
- Before tensioning ribbed belt for generator and coolant pump, rotate compressor belt pulley and check ribbed belt for correct seating in the belt pulley.
- Before installing ribbed belt for A/C compressor, secure tensioning device using the Locking Pin - T10060A- .



Note

When installing ribbed belt, note the belt direction of rotation and be sure that it is seated correctly in the belt pulleys.

- Start the engine and check the belt running.



4.2 Brake Booster Vacuum Pump

Special tools and workshop equipment required

- ♦ Torque Wrench 1331 5-50Nm - VAG1331-



Note

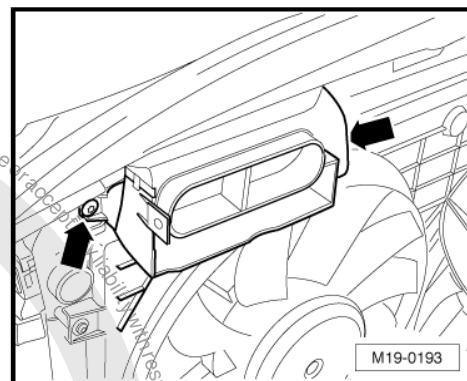
Due to installation conditions, the transmission must be removed on vehicles with automatic transmission.

Removing

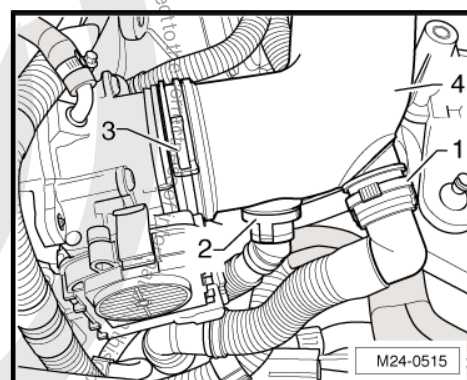
- Remove the engine cover with air filter. Refer to ⇒ [“4.1 Engine Cover with Air Filter”, page 216](#) .
- Remove the battery and the battery tray. Refer to ⇒ Electrical Equipment; Rep. Gr. 27 ; Battery, Removing and Installing; Vehicles with Gasoline Engine .



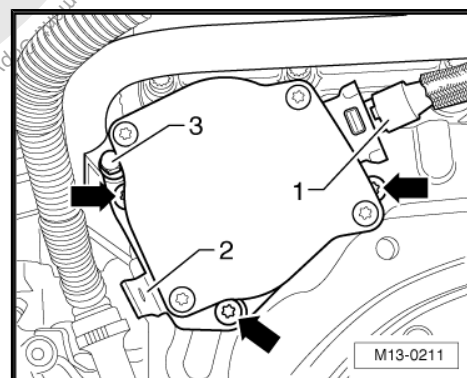
- Remove the intake air connection from the lock carrier -arrows-.



- Remove the intake hose -4-. Remove the air hoses -1- (if equipped) and -2- (press the locking ring) and the spring clamp -3-.



- Unclip wiring harness from bracket -2-.
- Remove the bolt -3- from the coolant pipe.
- Disconnect the vacuum hose -1-.
- Remove the three bolts -arrows- and the vacuum pump.



Note

The 4 cover bolts must not be loosened under any circumstances!

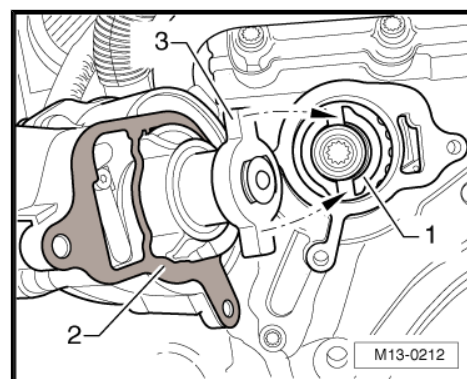
- Remove the old gasket.

Installing

- Place the new seal -2- on the vacuum pump.
- Place vacuum pump coupling plate -3- so that it engages into symmetrical groove of double chain sprocket (drive wheel) -1- -arrows- when installing vacuum pump.
- Tighten the bolts.

The rest of the installation follows the reverse of the removal procedures.

- Install the battery. Refer to ⇒ Electrical Equipment; Rep. Gr. 27 ; Battery, Removing and Installing; Vehicles with Gasoline Engine .



Tightening Specifications

Component	Nm
Vacuum pump to control housing cover	10
Coolant pipe to bracket	10



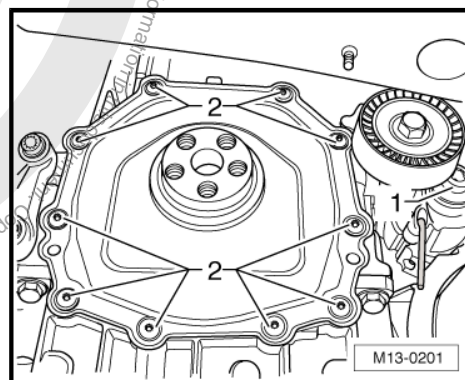
4.3 Crankshaft Sealing Flange, Belt Pulley Side

Special tools and workshop equipment required

- ◆ Trim Removal Wedge - 3409-
- ◆ Oil Seal Guide Sleeve - T03004-
- ◆ Hand Drill With Plastic Brush Attachment
- ◆ Protective eyewear
- ◆ Silicone Sealant - D 174 003 A2-

Removing

- Remove the A/C compressor ribbed belt. Refer to
⇒ ["4.1 Ribbed Belt", page 43](#) .
- Secure the crankshaft. Refer to
⇒ ["3.2 Crankshaft, Locking", page 38](#) .
- Remove the crankshaft belt pulley.
- Remove the tensioner -1-.
- Remove the bolts -2-.



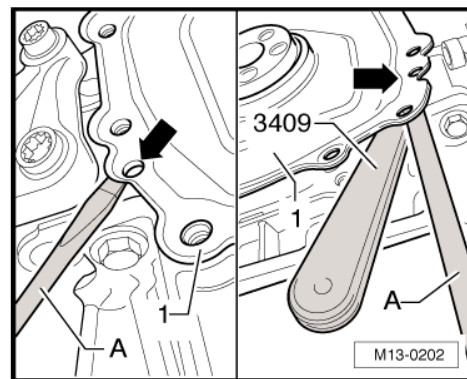


- Beginning at the alignment sleeves -arrows-, remove the sealing flange -1- with a screwdriver -A-.
- Use Trim Removal Wedge - 3409- to support screwdriver in order to prevent damage to the cylinder block sealing surface.
Sealing flange is damaged while removing.
- Press off sealing flange completely.



Note

Clean the Trim Removal Wedge - 3409- after removing the sealing flange, because it is intended for removal of interior trim components.



Installing



WARNING

To prevent injuries from shavings, wear protective goggles and protective clothing.

- Remove remainder of sealant from cylinder block for example using a rotating plastic brush.



Caution

Make sure that no sealant residue enters the engine.

- Clean sealing surface of cylinder block and crankshaft journals; they must be free of oil and grease.

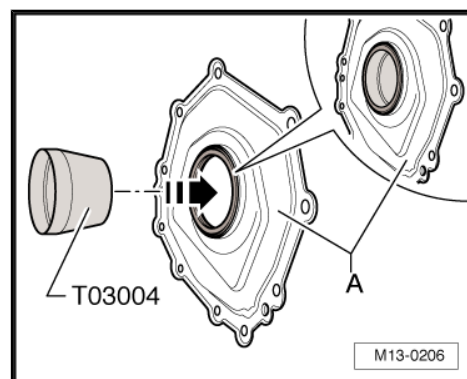


Note

- ◆ *Do not additionally oil or grease sealing lip of sealing flange!*
- ◆ *The following work steps must be followed so that the sealing lip of sealing flange does not roll itself up when installing.*

- Widen sealing lip of new sealing flange as illustrated using Oil Seal Guide Sleeve - T03004- .

The surface -A- is the outer side.



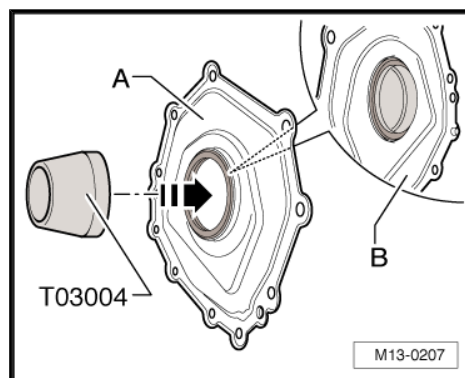


- After a short while, remove the Oil Seal Guide Sleeve - T03004- and turn it 180° rotated in the seal.

The Oil Seal Guide Sleeve - T03004- must protrude approximately 3 mm on the inner side -B-.

The surface -A- is the outer side.

The surface -B- is the inner side (sealing surface).

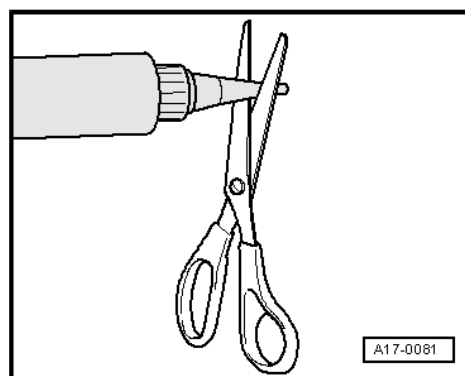


- Cut the tube nozzle at the front marking (nozzle diameter: approximately 2 mm).



Note

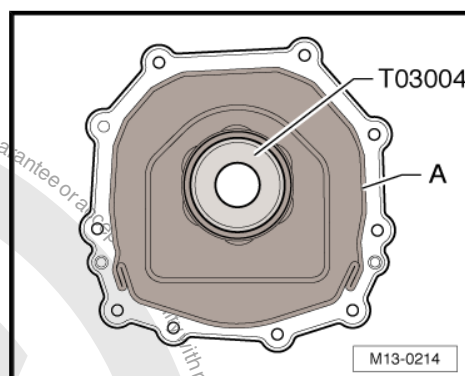
The sealing flange for crankshaft -belt pulley side- must be installed within 5 minutes after application of sealant.



- Apply sealant bead -A- as illustrated into groove of sealing flange.

◆ Sealant bead width: 2.5 to 3.0 mm

◆ Seal bead height over the sealing surface: approximately 1.0 mm





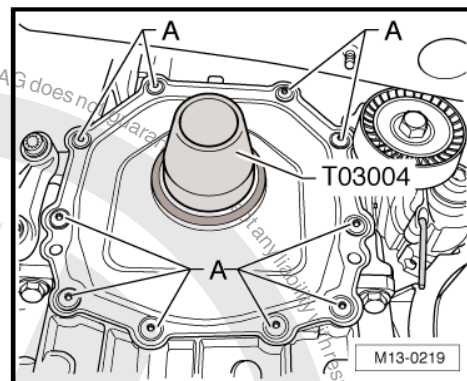
- Insert sealing flange using Oil Seal Guide Sleeve - T03004- on crankshaft journals and press uniformly on the cylinder block.
- Tighten the bolt -A- evenly and in a diagonal sequence.

The rest of the installation follows the reverse of the removal procedures. Note the following:

- ◆ Remove the Crankshaft Locking Pin - T40069- from the back of the cylinder block and install the bolt.

Tightening Specifications

Component	Nm
Belt pulley to crankshaft	50 Nm + 90° (1/4 turn) additional turn replace the bolts
Tensioning element to auxiliary component bracket	35
Sealing flange to cylinder block	10
Sealing plug to cylinder block at rear	30



4.4 Control Housing Cover

Special tools and workshop equipment required

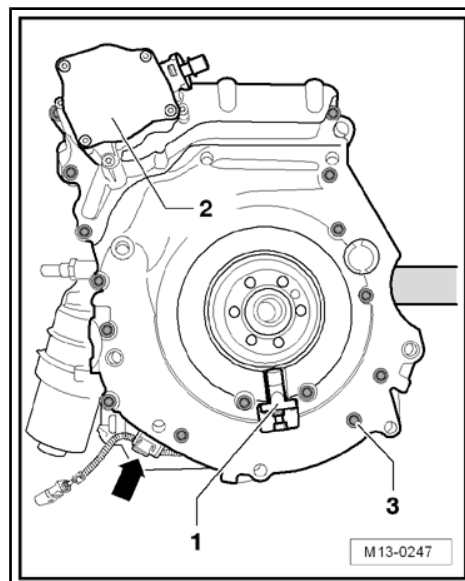
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Hand Drill With Plastic Brush Attachment
- ◆ Protective eyewear
- ◆ Silicone Sealant - D 174 003 A2-

Removing

- Engine removed, transmission disconnected from flange
- Remove the chain guard cover. Refer to [⇒ "4.2 Chain Guard Cover", page 71](#) .
- Remove flywheel or drive plate and remove sensor wheel for Engine Speed Sensor - G28- from crankshaft.
- Remove the cylinder head. Refer to [⇒ "4.4 Cylinder Head", page 74](#) .



- Disengage the wiring harness -arrow- and remove Engine Speed Sensor - G28- -1- and vacuum pump -2-.
- Remove the bolts -3-.



- Remove the control housing cover -1- from the cylinder block -2- or from the oil pan upper section -3- by pressing on the top and bottom using a screwdriver -A-.

Start in area of the alignment bushings -arrows-.



Note

When installing, make sure that the sealing surfaces do not become damaged.

- Drive out the seal with the control housing cover removed.

Installing



WARNING

To prevent injuries from shavings, wear protective goggles and protective clothing.

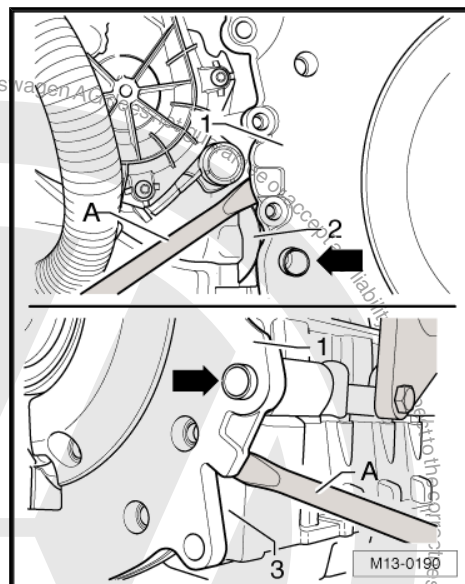
- Remove the sealant residue from the cylinder block, oil pan upper section and control housing cover, for example with a rotating plastic brush.



Caution

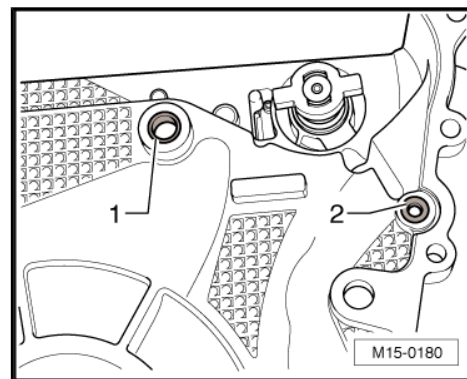
Make sure that no sealant residue enters the engine.

- Clean the sealing surfaces of cylinder block, oil pan upper section and control housing cover, they must be free of oil and grease.





- Replace the seals -1- and -2-.

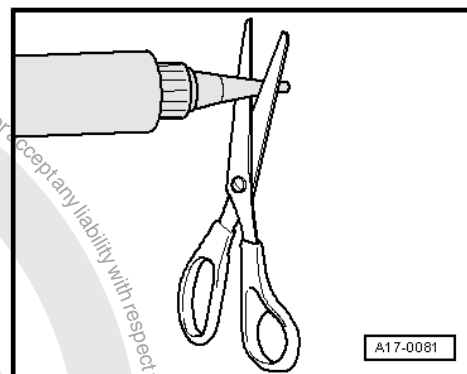


- Cut the tube nozzle at the front marking (nozzle diameter: approximately 1 mm).

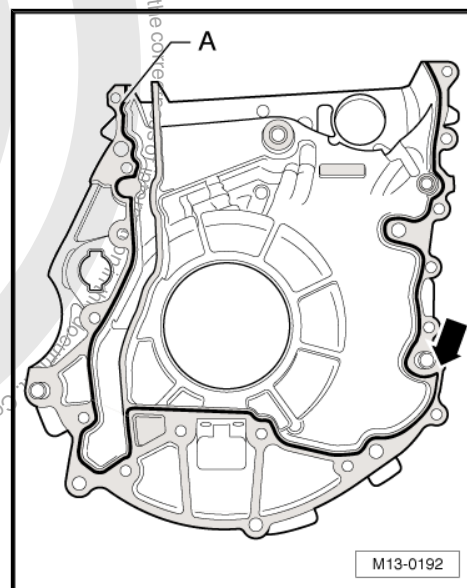


Note

The control housing cover must be installed within five minutes after application of sealant.



- Apply a bead of sealant -A- on the control housing cover as illustrated.
- ◆ Sealant bead must be 1.5 to 2.0 mm thick.
- ◆ Pay special attention to course of sealant bead in area -arrow-.
- Attach the control housing cover so that the alignment bushings engage in bores in cylinder block.
- Screw in all the bolts hand-tight.





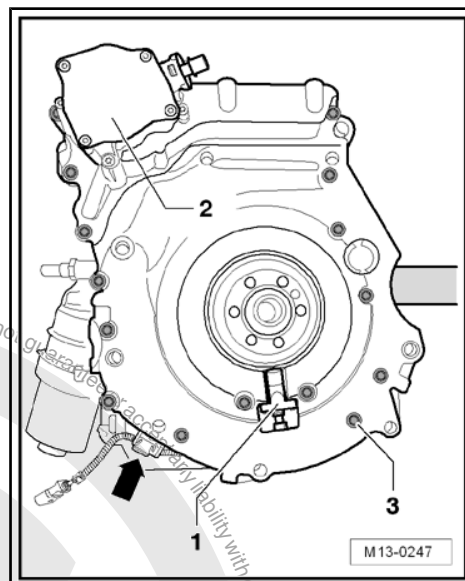
- First tighten all the bolts -3- in the cylinder block and in the upper section of the oil pan to 10 Nm.
- Finally, tighten the bolts in the cylinder block and in the upper section of the oil pan to 25 Nm.
- Wipe off any sealant, which has leaked out.
- Drive the alignment sleeves in as far as the stop if necessary.
- Install a new sealing ring
⇒ [“4.5 Sealing Ring on Transmission Side”, page 52](#)

The rest of the installation follows the reverse of the removal procedures. Note the following:

- ♦ Install the brake booster vacuum pump. Refer to
⇒ [“4.2 Brake Booster Vacuum Pump”, page 44](#) .
- ♦ Install the cylinder head ⇒ [“4.4 Cylinder Head”, page 74](#) .
- ♦ Install the drive plate. Refer to
⇒ [“4.6 Drive Plate”, page 53](#) .
- ♦ Remove the Crankshaft Locking Pin - T40069- from the back of the cylinder block and install the bolt.
- ♦ Fill the coolant. Refer to
⇒ [“4.1 Coolant, Draining and Filling”, page 123](#) .

Tightening specifications:

Component	Nm
Flywheel/drive plate to crankshaft ♦ Replace bolts	60 Nm +90°
Sealing plug to cylinder block at rear	30



4.5 Sealing Ring on Transmission Side

Special tools and workshop equipment required

- ♦ Seal Installer - Crankshaft - T10122A-
- ♦ Puller - Crankshaft/Power Steering Seal - T20143-

Removing

- Remove the transmission.
- Secure the crankshaft. Refer to
⇒ [“3.2 Crankshaft, Locking”, page 38](#) .
- Remove flywheel or drive plate and remove sensor wheel for Engine Speed Sensor - G28- from crankshaft.
- Remove the seal using the Puller - Crankshaft/Power Steering Seal - T20143/2- .

Be careful not to damage the crankshaft sealing surface.

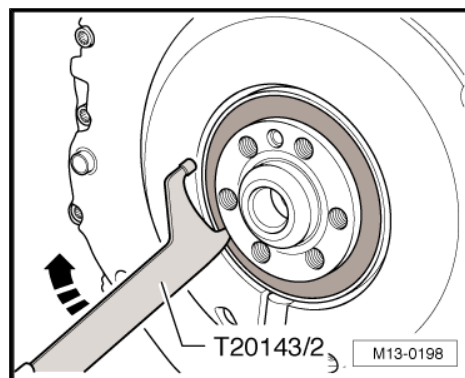
Installing



Note

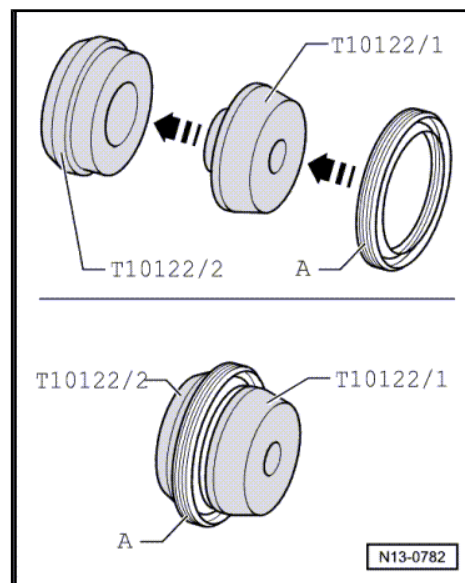
Do not coat the lip on the seal with oil or grease.

- Clean sealing surfaces. They must be free of oil and grease.
- Wipe off any oil that may still be on the end of the crankshaft with a clean cloth.





- Position assembly device -T10122/1- on pull sleeve - T10122/2- and slide seal -A- onto the pulling sleeve.
- Remove the Seal Installer - Crankshaft - Assembly Device - T10122/1- .



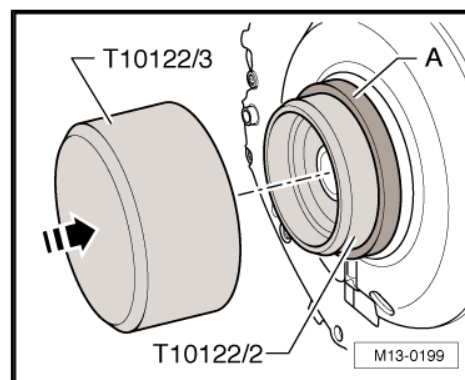
- Install Seal Installer - Crankshaft - Pulling Sleeve - T10122/2- with sealing ring -A- onto crankshaft.
- Press in sealing ring all around evenly and flush using Seal Installer - Crankshaft - T10122/3- .

The rest of the installation follows the reverse of the removal procedures. Note the following:

- ◆ Remove the Crankshaft Locking Pin - T40069- from the back of the cylinder block and install the bolt.

Tightening specifications:

Component	Nm
Flywheel/drive plate to crankshaft ◆ Replace bolts	60 Nm +90°
Sealing plug to cylinder block at rear	30



4.6 Drive Plate

Special tools and workshop equipment required

- ◆ Depth Gauge

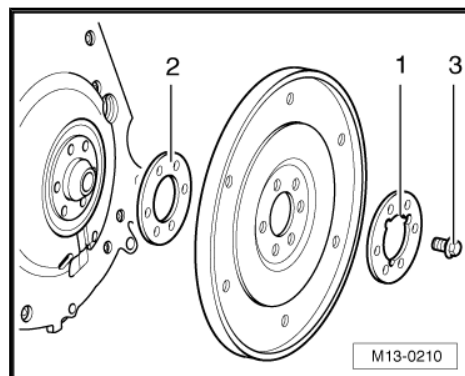
Removing

- Remove the transmission.
- Secure crankshaft (refer to ["3.2 Crankshaft, Locking", page 38](#) and remove drive plate.



Installing

- Install drive plate only by using washer with recesses -1- (without compensating shim -2-).
- Install the new bolts -3- and tighten to 30 Nm.



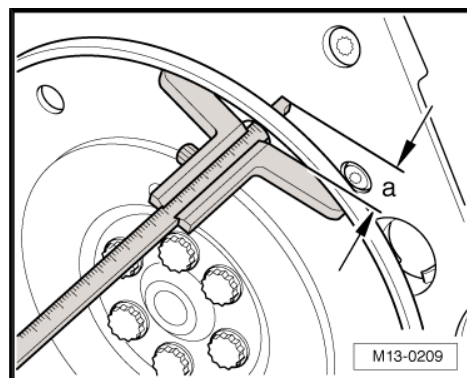
- Check dimension -a- at three points and calculate mean value.

Specified value: 8.7 to 20.4 mm



Note

Measure through drive plate hole to surface of control housing cover.



If the specification is not obtained:

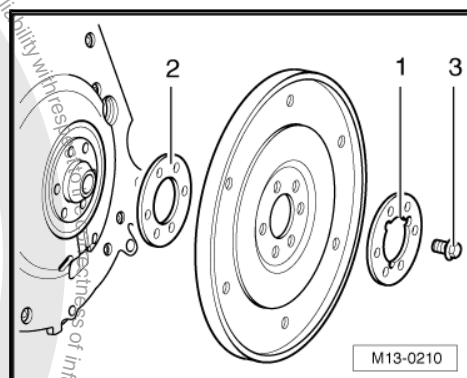
- Remove drive plate again and use shim -2-. Tighten the bolts -3- again to 30 Nm and repeat the measurement.

If the specified value is OK:

- Tighten bolts to 60 Nm and turn an additional + 90° (1/4 rotation, additional rotation may occur in several stages).

The rest of the installation follows the reverse of the removal procedures. Note the following:

- ◆ Remove the Crankshaft Locking Pin - T40069- from the cylinder block at the rear and install the plug (30 Nm).





5 Disassembly and Assembly

⇒ **"5.1 New Connecting Rod, Separating", page 55**

5.1 New Connecting Rod, Separating

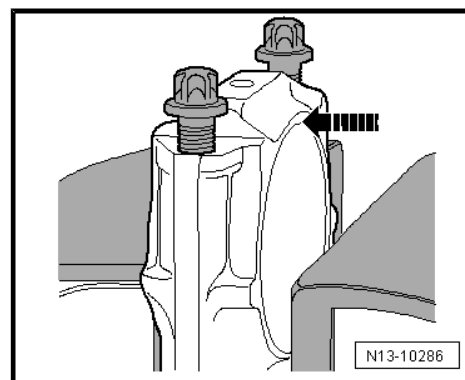
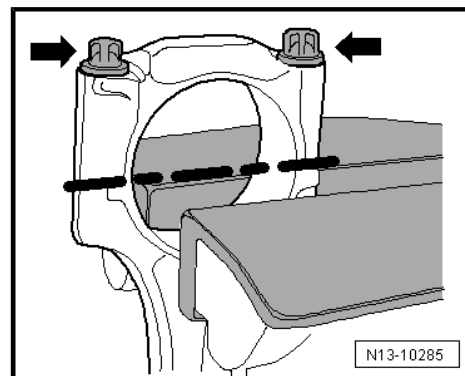
New connecting rods might not be separated at the location where they should be. If the connecting rod bearing cap cannot be removed by hand, proceed as follows:

- Mark which cylinder belongs to the connecting rod -item 4- ⇒ **Item 4 (page 36)** .
- Lightly clamp the connecting rod in a vise equipped with aluminum protective pads.



Note


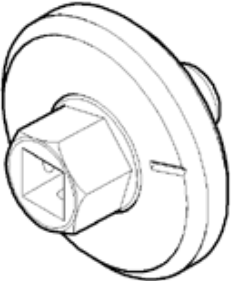
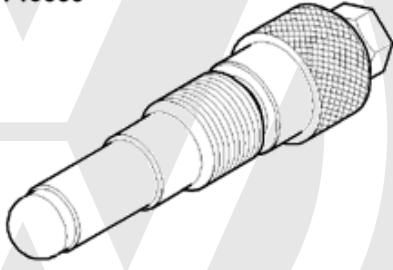

- ◆ *Only clamp the connecting rod lightly to avoid damaging it.*
- ◆ *Clamp the connecting rod below the dotted line.*
- Loosen both bolts -arrows- about five turns.
- Carefully tap against the connecting rod bearing cap in direction of -arrow- with a plastic hammer to loosen cap.



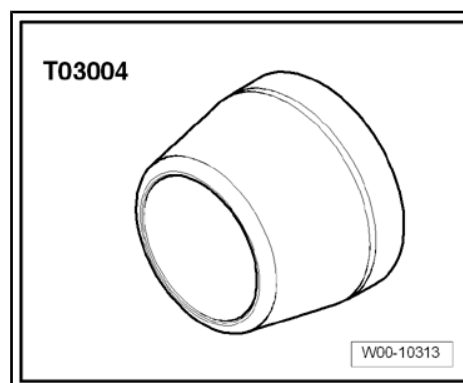


6 Special Tools

Special tools and workshop equipment required

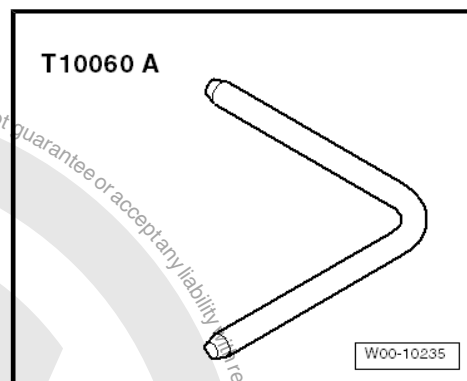
V.A.G 1331 	T03003 
T40069 	
	W13-10015

- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Crankshaft Adapter - T03003-
- ◆ Crankshaft Locking Pin - T40069-
- ◆ Oil Seal Guide Sleeve - T03004-

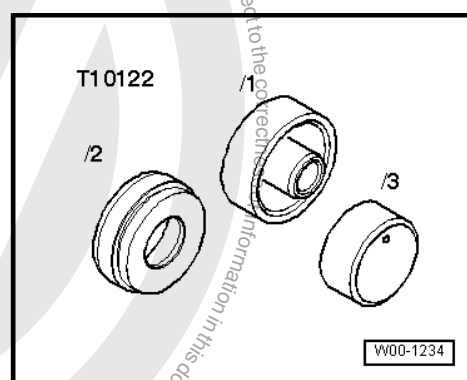




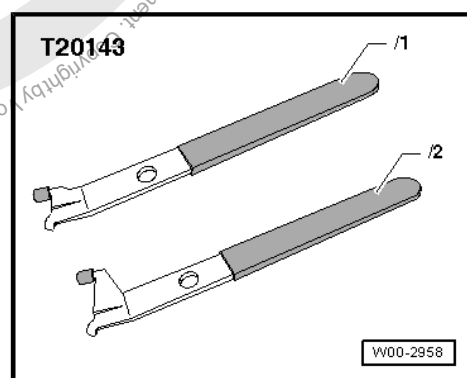
◆ Locking Pin - T10060A-



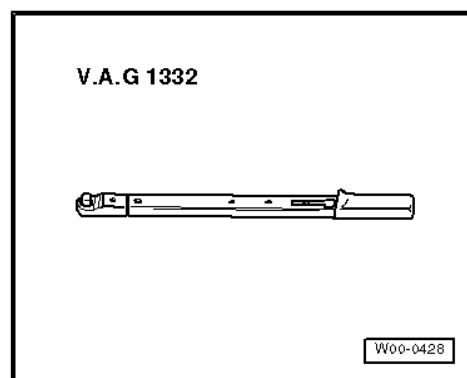
◆ Seal Installer - Crankshaft - T10122A-



◆ Puller - Crankshaft/Power Steering Seal - T20143-



◆ Torque Wrench 1332 40-200Nm - VAG1332-





◆ Trim Removal Wedge - 3409-





15 – Cylinder Head, Valvetrain

1 General Information

⇒ [“1.1 Cylinder Head”, page 59](#)

⇒ [“1.2 Valvetrain”, page 59](#)

1.1 Cylinder Head



Note

- ◆ If a replacement cylinder head is installed, several contact surfaces between support elements, roller cam follower and cam lubricating surfaces of camshaft must be oiled before installing the cylinder head cover.
- ◆ The plastic protectors installed to protect the open valves must only be removed immediately before fitting the cylinder head.
- ◆ Replace the cylinder head bolts.
- ◆ When the replacing cylinder head or cylinder head gasket, the coolant must be completely replaced.

1.2 Valvetrain



Note

- ◆ Cylinder heads with cracks between the valve seats, or between the valve seat and the spark plug threads, can continue to be used without reducing the service life, as long as the cracks have a width of max. 0.3 mm, or only the first 4 threads of the spark plug threads are cracked.
- ◆ The cylinder head and guide frame must be replaced together.
- ◆ Do not re-grind valve seats in cylinder head, only hand-lapping the valves is permitted.
- ◆ Do not start the engine for approximately 30 minutes after installing the camshafts. The hydraulic adjusting elements must seat themselves (otherwise the valves will seat themselves on the pistons).
- ◆ After working on the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before starting to be sure that valves do not strike the pistons.
- ◆ Always replace the gaskets and seals.



2 Description and Operation

⇒ [“2.1 Overview - Cylinder Head”, page 60](#)

⇒ [“2.2 Overview - Valvetrain”, page 62](#)

2.1 Overview - Cylinder Head

1 - Bolt

- ❑ 10 Nm

2 - Cylinder Head Cover

- ❑ With pressure regulator valve for crankshaft housing ventilation
- ❑ Tightening sequence. Refer to
⇒ [Fig. “Tightening sequence for cylinder head cover”, page 61](#)
- ❑ Removing and installing. Refer to
⇒ [“4.1 Cylinder Head Cover”, page 70](#).

3 - Cylinder Head Cover Gasket

- ❑ Replace if damaged or leaking

4 - Bleeder Hose for Crankcase Ventilation

- ❑ To the intake manifold

5 - Oil Filler Cap

6 - Seal

- ❑ Replace if damaged or leaking

7 - Bolt

- ❑ 10 Nm

8 - Wiring Bracket

9 - Seal

- ❑ Replacing. Refer to
⇒ [“4.3 Chain Guard Cover Seal”, page 73](#).

10 - Wiring Bracket

11 - Chain Guard Cover

- ❑ Removing and installing. Refer to ⇒ [“4.2 Chain Guard Cover”, page 71](#).

12 - Bolt

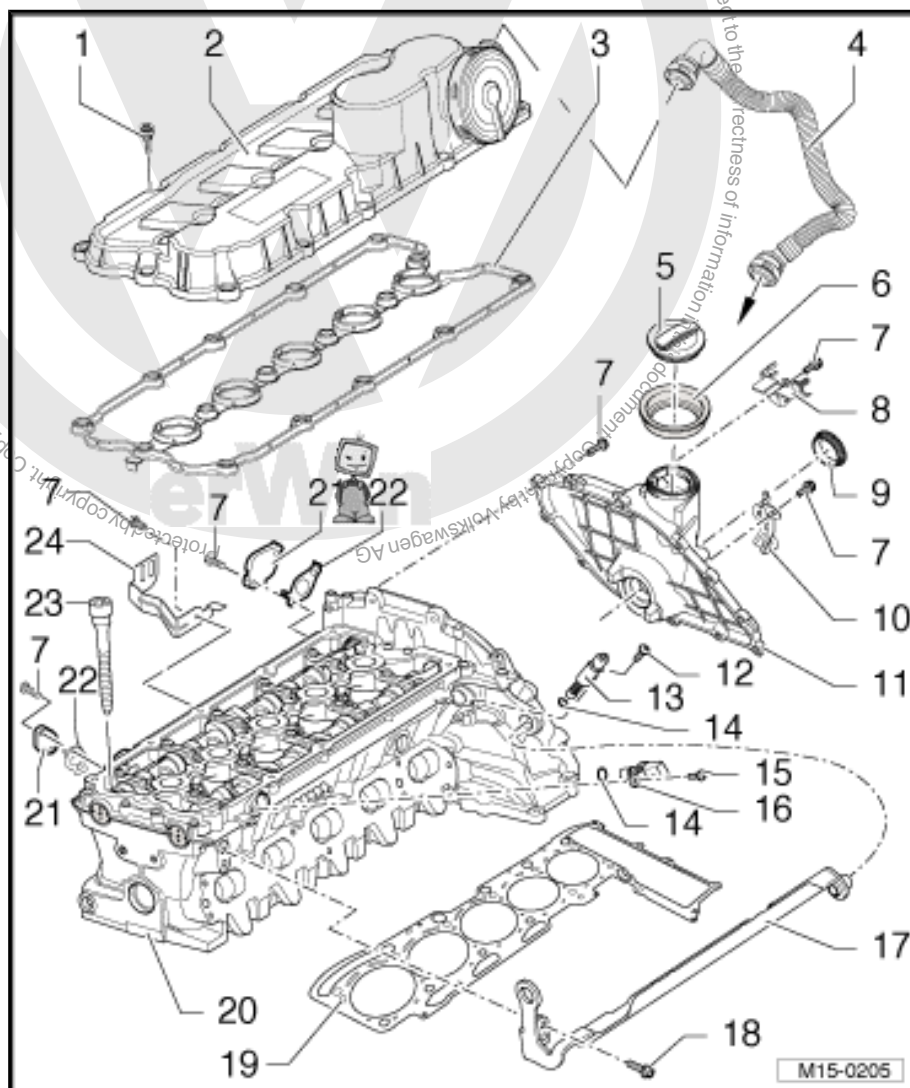
- ❑ 2 Nm

13 - Camshaft Adjustment Valve 1 - N205-

- ❑ Check with Vehicle Diagnostic Tester

14 - O-Ring

- ❑ Replace if damaged
- ❑ No replacement part for the Camshaft Position Sensor - G40- (-item 16- ⇒ [Item 16 \(page 61\)](#))





15 - Bolt

- ☐ 10 Nm

16 - Camshaft Position Sensor - G40-

17 - Transport strap

18 - Bolt

- ☐ 25 Nm

19 - Cylinder Head Gasket

- ☐ Replace
- ☐ After replacing, replace entire amount of coolant.

20 - Cylinder Head

- ☐ Removing and installing. Refer to ⇒ [“4.4 Cylinder Head”, page 74](#) .
- ☐ Checking cylinder head for warping. Refer to
 ⇒ [Fig. “Checking cylinder head for distortion”](#) , page 62
- ☐ It is not permitted to rework sealing surface
- ☐ With coolant pipe connection pressed in
 - If necessary, remove coolant deposits using a copper wire brush or fine sandpaper (minimum 100 grit).
 - If the pipe connection is worn, replace it using Locking Fluid - D 000600 A2- .

21 - Cap

- ☐ Only on engines with the secondary air injection system
- ☐ Engines with Secondary Air Injection System. Refer to
 ⇒ [“2.5 Overview - Secondary Air Injection System”, page 242](#)

22 - Seal

- ☐ Replace

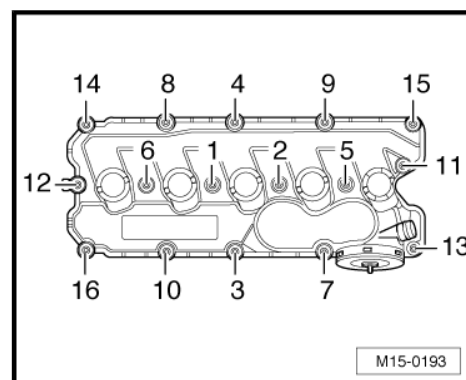
23 - Cylinder Head Bolt

- ☐ Replace
- ☐ Follow the loosening/tightening sequence. Refer to ⇒ [“4.4 Cylinder Head”, page 74](#)
- ☐ Tightening specification: 40 Nm + additional 180° (1/2 turn) additional turn

24 - Wiring Bracket

- ☐ For Heated Oxygen Sensor - G39-

Tightening sequence for cylinder head cover



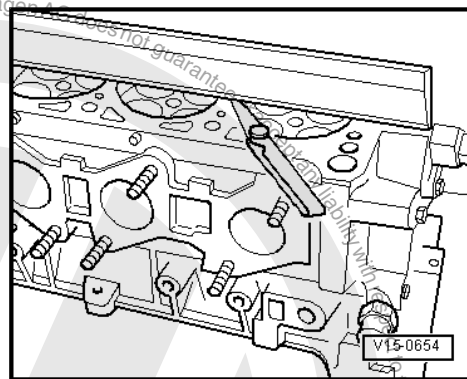


Checking cylinder head for distortion

- Check cylinder head at multiple points for distortion, using straight edge and feeler gauges.

♦ Maximum permissible distortion: 0.05 mm

If this value is exceeded, cylinder head must be replaced. It is not permissible to rework the sealing surface.



2.2 Overview - Valvetrain

1 - Bolt

- ☐ 8 Nm + 90° (1/4 turn) additional turn
- ☐ Replace

2 - Guide Frame

- ☐ Removing and installing. Refer to ["4.6 Camshafts", page 81](#).
- ☐ With integrated camshaft bearings
- ☐ Clean sealing surface, reworking is not permitted.
- ☐ Remove old sealant residue.

3 - Chain Sprocket

- ☐ For exhaust camshaft

4 - Bolt

- ☐ 60 Nm + 90° (1/4 turn) additional turn
- ☐ Replace

5 - Bolt

- ☐ 60 Nm + 90° (1/4 turn) additional turn
- ☐ Replace

6 - Camshaft Adjuster

- ☐ For intake camshaft

7 - Seals

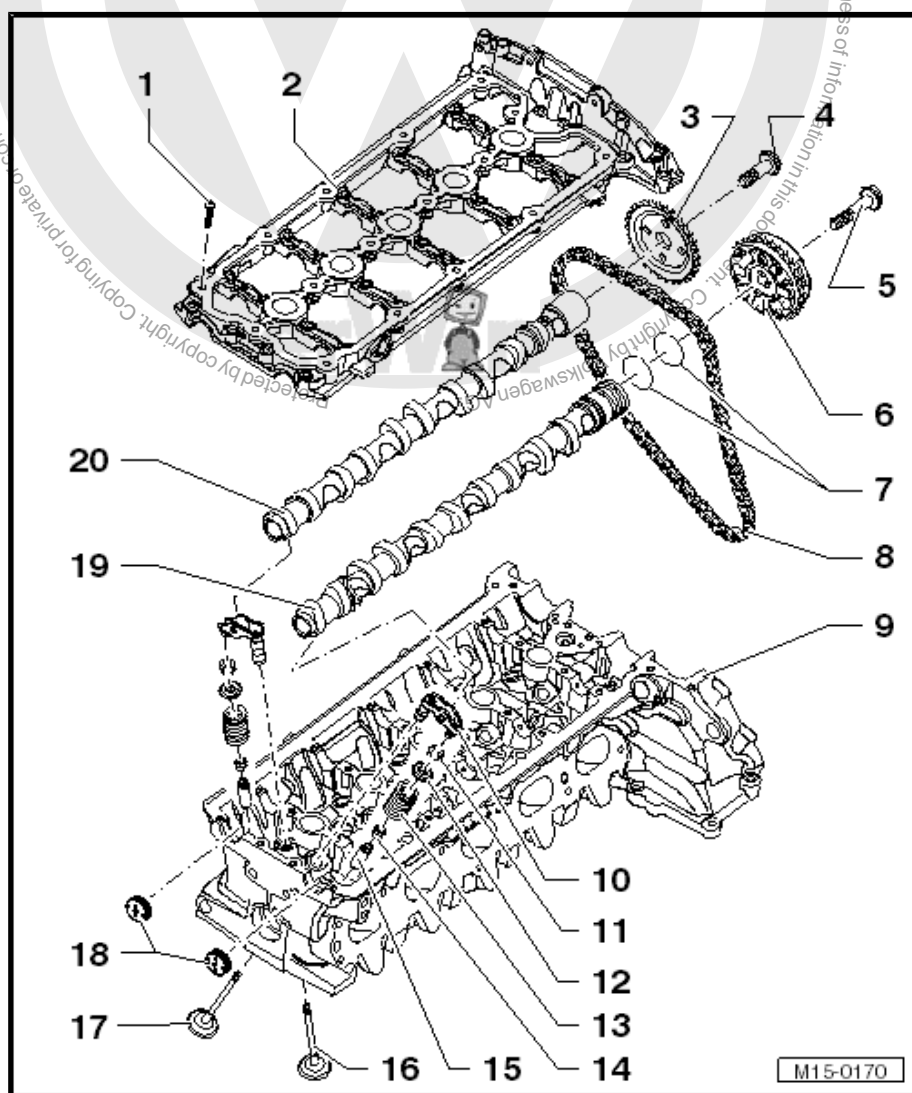
- ☐ For camshaft adjuster
- ☐ Note the installation position ["4.6 Camshafts", page 81](#).

8 - Timing Chain

- ☐ Removing from chain sprockets (refer to ["3.2 Valve Timing, Adjusting", page 64](#)), adjusting valve timing

9 - Cylinder Head

- ☐ Do not re-grind valve seats, only hand-lapping is permitted.





10 - Hydraulic Valve Play Balancing Element

- ☐ Do not interchange
- ☐ Lubricate contact surface

11 - Valve Retainers

12 - Upper Valve Spring Retainer

13 - Valve Spring

14 - Valve Stem Seal

- ☐ Replacing. Refer to ⇒ [“4.5 Valve Stem Seals”, page 78](#) .

15 - Valve Guide

- ☐ Checking. Refer to ⇒ [“3.5 Valve Guides, Checking”, page 69](#) .

16 - Intake Valve

- ☐ Do not rework, only grinding is permitted
- ☐ Valve dimensions ⇒ [“3.4 Valve Dimensions”, page 68](#)
- ☐ Valve guides, checking. Refer to ⇒ [“3.5 Valve Guides, Checking”, page 69](#) .

17 - Exhaust Valve

- ☐ Do not rework, only grinding is permitted
- ☐ Valve dimensions ⇒ [“3.4 Valve Dimensions”, page 68](#)
- ☐ Valve guides, checking. Refer to ⇒ [“3.5 Valve Guides, Checking”, page 69](#) .

18 - Sealing Plugs

- ☐ Replace
- ☐ Installing. Refer to ⇒ [“4.6 Camshafts”, page 81](#)

19 - Intake Camshaft

- ☐ Removing and installing. Refer to ⇒ [“4.6 Camshafts”, page 81](#) .
- ☐ Check radial clearance using Plastigage® (roller rocker lever removed)

Wear limit: 0.1 mm

- ☐ Stroke: maximum 0.035 mm
- ☐ Axial play: maximum 0.17 mm

20 - Exhaust Camshaft

- ☐ Removing and installing. Refer to ⇒ [“4.6 Camshafts”, page 81](#) .
- ☐ Check radial clearance using Plastigage® (roller rocker lever removed)

Wear limit: 0.1 mm

- ☐ Stroke: maximum 0.035 mm
- ☐ Axial play: maximum 0.17 mm



3 Diagnosis and Testing

⇒ [“3.1 Valve Timing, Checking”, page 64](#)

⇒ [“3.2 Valve Timing, Adjusting”, page 64](#)

⇒ [“3.3 Compression Pressure, Checking”, page 67](#)

⇒ [“3.4 Valve Dimensions”, page 68](#)

⇒ [“3.5 Valve Guides, Checking”, page 69](#)

3.1 Valve Timing, Checking

Special tools and workshop equipment required

- ◆ Camshaft Clamp - T40070-

Procedure

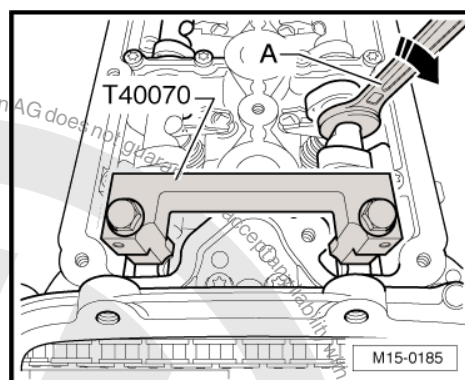
- Remove the cylinder head cover. Refer to
⇒ [“4.1 Cylinder Head Cover”, page 70](#) .
- Secure the crankshaft to check the valve timing. Refer to
⇒ [page 39](#) .

Valve timing is correct

Valve timing is correct when the Camshaft Clamp - T40070- bolts can be screwed in easily to the end into camshafts as shown. The Camshaft Clamp - T40070- support surfaces must lie flat on flat area of camshaft when doing this.

- If it is difficult to install the bolts, use an open-end wrench -A- (18 mm or 19 mm) at the notches of the exhaust camshaft and try to turn it slightly in direction of -arrow- or eliminate possible play that may be present in the chain drive.

If the Camshaft Clamp - T40070- bolt can now be screwed in easily with chain drive tensioned in this manner, valve timing is also correct. Possibly the crankshaft was not secured correctly.



Valve timing is not correct.

Valve timing is not correct when bolts of Camshaft Clamp - T40070- cannot be screwed in easily to the end into camshafts despite the tensioned chain drive.

- ◆ In this case it is necessary to adjust the valve timing. Refer to
⇒ [“3.2 Valve Timing, Adjusting”, page 64](#) .

Assembly

Assembly is performed in the reverse order of removal. Note the following:

- ◆ Remove the Crankshaft Locking Pin - T40069- from the cylinder block at the rear and install the plug (30 Nm).

3.2 Valve Timing, Adjusting

Special tools and workshop equipment required

- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Locking Pins - T03006-
- ◆ Multipoint Socket - T10035-
- ◆ Counterhold - Kit - Multiple Use - T10172-
- ◆ Camshaft Clamp - T40070-



- ◆ Two M8 x 16 bolts

Retrofit Counterhold - Kit - Multiple Use - T10172-

- Remove Counterhold - Kit - Multiple Use - Adapter - T10172/1- and install the M8 x 16 bolts -A-.



Note

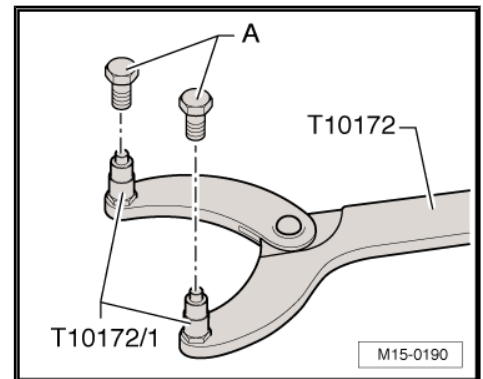
The valve timing must be adjusted if the camshaft chain sprockets were loosened during repairs or if the valve timing is not set.

Securing camshafts if the valve timing is correct:

- Remove the chain guard cover. Refer to ➤ [“4.2 Chain Guard Cover”, page 71](#) .
- Remove the cylinder head cover. Refer to ➤ [“4.1 Cylinder Head Cover”, page 70](#) .
- Lock the crankshaft in place to adjust the valve timing. Refer to ➤ [page 39](#) .

- Screw the Camshaft Clamp - T40070- onto the camshafts, as shown, and tighten the bolts to 20 Nm.

If it is difficult to install the bolts, use an open-end wrench -A- (18 mm or 19 mm) at the notches of the exhaust camshaft and try to turn it slightly in direction of -arrow- or eliminate possible play that may be present in the chain drive.

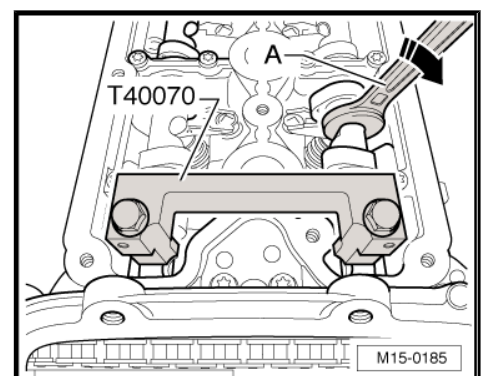
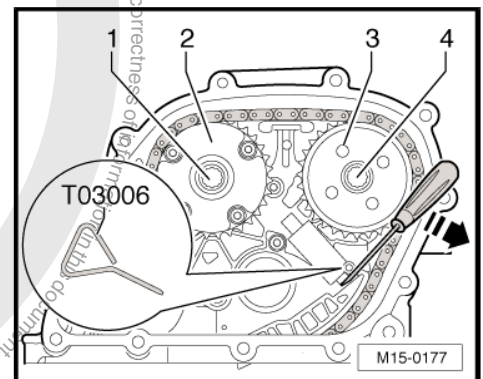
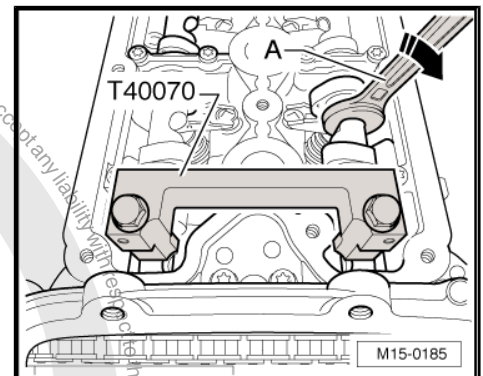


- Relieve the tension on the timing chain. To do this, insert an appropriate screwdriver between the piston of the chain tensioner and the tensioning rail and press in direction of -arrow-.
- Secure the completely pressed in piston using the Locking Pins - T03006- . The locking pin must be inserted all the way.

Securing camshafts if the valve timing is not correct.

- Remove the chain guard cover. Refer to ➤ [“4.2 Chain Guard Cover”, page 71](#) .
- Rotate crankshaft to TDC cylinder 5 (refer to ➤ [page 39](#)), however do not lock the crankshaft using Crankshaft Locking Pin - T40069- .
- Turn the crankshaft, as illustrated, to make it easier to attach the Camshaft Clamp - T40070- on the camshafts.
- Tighten the bolts on the Camshaft Clamp - T40070- to 20 Nm.

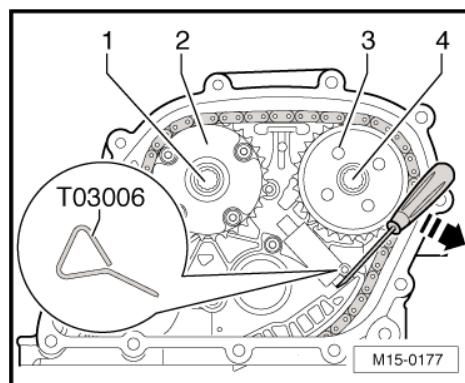
Removing the camshaft chain sprocket.





- Relieve the tension on the timing chain. To do this, insert an appropriate screwdriver between the piston of the chain tensioner and the tensioning rail and press in direction of -arrow-.
- Secure the completely pressed in piston using the Locking Pins - T03006- . The locking pin must be inserted all the way.
- Remove the bolts -1- and -4- and the chain sprockets -2- and -3- . Use the Multipoint Socket - T10035- .

If necessary, chain sprocket -3- must be pressed off lightly using a screwdriver.



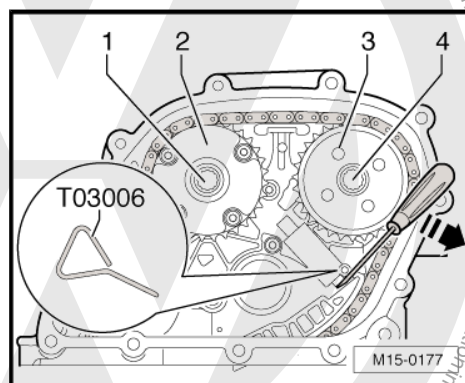
Note

Secure crankshaft if it is not yet secured. Refer to
⇒ ["3.2 Crankshaft, Locking", page 38](#) . Crankshaft must only be
rotated slightly around TDC point for this. Otherwise there is a risk
the valves rest on the pistons.

Adjusting the valve timing

- Lock the crankshaft with the Crankshaft Locking Pin - T40069- .
- Secure the camshaft using the Camshaft Clamp - T40070- .
- Chain tensioner is tensioned
- Place the chain sprockets -2- and -3- into the timing chain, place them onto the camshafts and hand tighten the new bolts -1- and -4- .

Chain gears must still be able to be rotated, however they must not tilt.



Note

Make sure that the timing chain is correctly positioned in the slider
and tensioning rail.

- Release the tension on chain tensioner by pressing in the piston and pulling out the Locking Pins - T03006- .



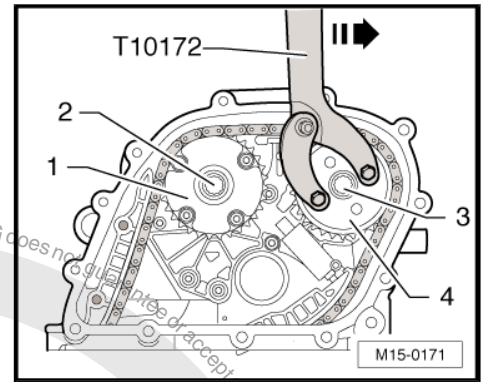
- Place the modified Counterhold - Kit - Multiple Use - T10172- on to chain sprocket for exhaust camshaft -4-.

i Note

A second technician will be needed for the rest of the procedure.

- Hold the timing chain at pre-load by pressing the Counterhold - Kit - Multiple Use - T10172- in the direction of -arrow-.
- At the same time, first tighten the bolt -2- of the intake camshaft and then the bolt -3- of the exhaust camshaft to 60 Nm.

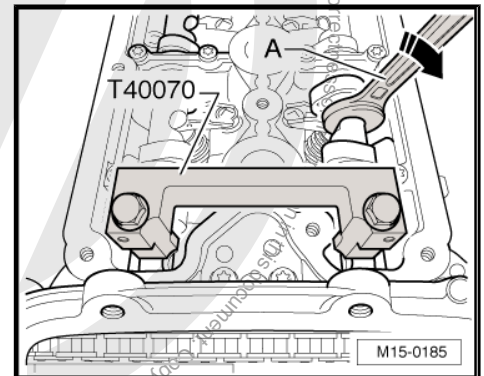
Then tighten bolts -2- and -3- an additional 90° (1/4 turn).



i Note

When applying the additional torque of 90°, timing chain must no longer be held at pre-load.

- Remove the Camshaft Clamp - T40070- .



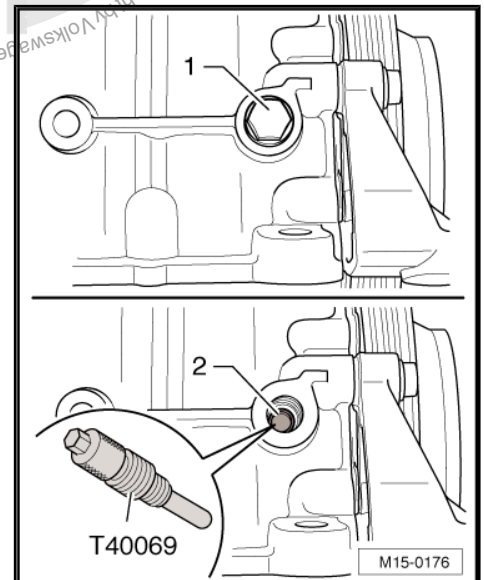
- Remove the Crankshaft Locking Pin - T40069- for locking the crankshaft in place.
- Turn the crankshaft 2 revolutions in engine running direction and secure the crankshaft. Refer to ➤ [page 39](#) , Securing crankshaft for inspection/adjustment of valve timing.
- Check the valve timing. Refer to ➤ ["3.1 Valve Timing, Checking"](#), [page 64](#) .

If valve timing is not correct:

- Loosen chain sprockets of camshafts again and adjust valve timing again (replace camshaft bolts).

The rest of the installation follows the reverse of the removal procedures. Note the following:

- ◆ Remove the Crankshaft Locking Pin - T40069- from the back of the cylinder block and install the bolt.
- ◆ Fill the coolant. Refer to ➤ ["4.1 Coolant, Draining and Filling"](#), [page 123](#) .



3.3 Compression Pressure, Checking

Special tools and workshop equipment required

- ◆ Spark Plug Removal Tool - 3122B-
- ◆ Puller - Ignition Coil - T40039-



- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Compression Tester Kit - VAG1763-
- ◆ Compression Tester Kit - Adapter 5A - VAG1381/5A-

Test conditions:

- Engine oil temperature must be at least 30 °C (86 °F).
- Voltage supply OK.
- Remove the engine cover with air filter. Refer to
⇒ [“4.1 Engine Cover with Air Filter”, page 216](#) .
- Pull connectors off all fuel injectors.
- Remove the ignition coils with power output stage. Refer to
⇒ [“4.1 Ignition Coils with Power Output Stages”, page 257](#) .
- Remove the spark plugs using Spark Plug Removal Tool - 3122B- .
- Check the compression pressure using the Compression Tester Kit - VAG1763- and Compression Tester Kit - Adapter 5A - VAG1381/5A- .



Note

For information on using the tester. Refer to the operating instructions.

- Have a second technician operate the starter.
- Operate the starter until tester shows no further pressure increase.

Compression pressure:

new bar positive pressure	Wear limit bar positive pressure	Difference between cylinders bar positive pressure
9.0 to 13.0	8.0	maximum 3.0

- Erase the engine control module DTC memory because faults were stored when the connector was disconnected earlier. Refer to
⇒ [“3.3 Engine Control Module DTC Memory, Checking and Erasing”, page 214](#) .

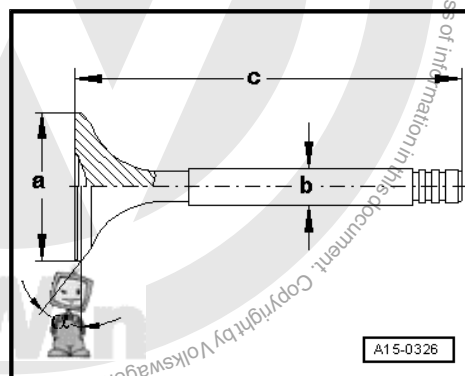
3.4 Valve Dimensions



Note

Intake and exhaust valves must not be reworked. Only grinding is permitted.

Dimension		Intake valve	Exhaust valve
Diameter a	mm	26.80 to 27.00	29.80 to 30.00
Diameter b	mm	5.95 to 5.97	5.94 to 5.95
c	mm	104.84 to 105.34	103.64 to 104.14
α	°	45	45

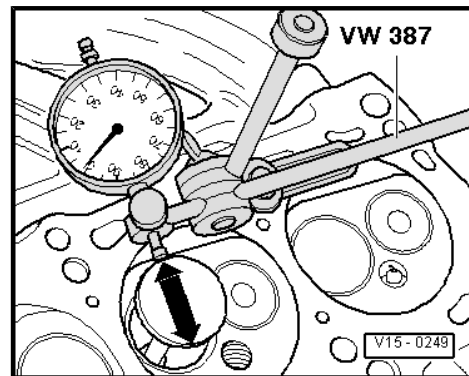




3.5 Valve Guides, Checking

Special tools and workshop equipment required

- ◆ Universal Dial Gauge Mount - MP 3-447-
 - ◆ Dial Gauge
 - Insert the new valve into the guide. The tip of the valve stem must seal with the guide. Due to differences in valve stem diameter, make sure that only intake valves are used to check intake valve guides, and only exhaust valves are used to check exhaust valve guides.
 - Determine the tilt clearance.
Wear limit: 0.8 mm
- If tilt clearance is exceeded:
- Replace the cylinder head.





4 Removal and Installation

⇒ [“4.1 Cylinder Head Cover”, page 70](#)

⇒ [“4.2 Chain Guard Cover”, page 71](#)

⇒ [“4.3 Chain Guard Cover Seal”, page 73](#)

⇒ [“4.4 Cylinder Head”, page 74](#)

⇒ [“4.5 Valve Stem Seals”, page 78](#)

⇒ [“4.6 Camshafts”, page 81](#)

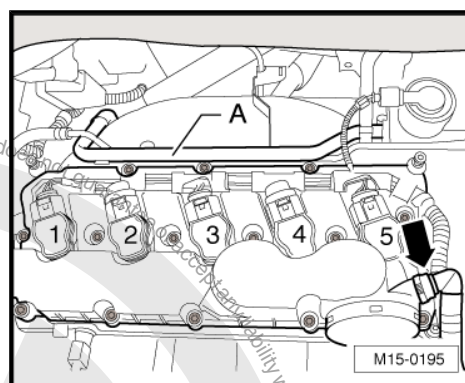
4.1 Cylinder Head Cover

Special tools and workshop equipment required

- ◆ Torque Wrench 1331 5-50Nm - VAG1331-

Removing

- Remove the engine cover with air filter. Refer to
⇒ [“4.1 Engine Cover with Air Filter”, page 216](#) .
- Remove the air hose from the crankcase ventilation -arrow-.
- Remove connecting pipe -A-.
- Remove the ignition coils -1 to 5-. Refer to
⇒ [“4.1 Ignition Coils with Power Output Stages”, page 257](#) .



- Remove bolts for cylinder head cover in the sequence
-16 to 1-.

Installing

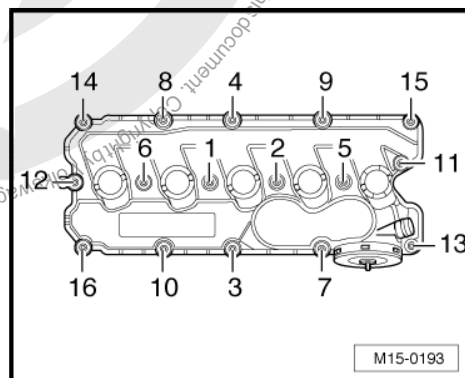
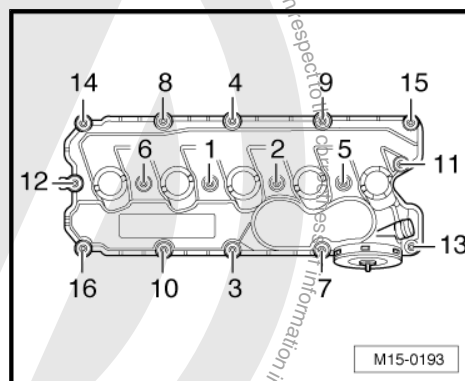
Install in reverse order of removal. Note the following:



Note

Replace cylinder head cover gasket if damaged or leaking.

- Clean the sealing surfaces, they must be free of oil and grease.
- Tighten the cylinder head cover bolts in the following sequence: -1 to 16-.
- Observe tightening sequence when installing connecting pipe -A-. Refer to
⇒ [Fig. “Connecting tube -tightening sequence”](#),
[page 244](#) .



Component	Nm
Cylinder head cover to cylinder head	10
Connecting pipe for the secondary air to the cylinder head.	10



4.2 Chain Guard Cover

Special tools and workshop equipment required

- ◆ Trim Removal Wedge - 3409-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Hand Drill With Plastic Brush Attachment
- ◆ Protective eyewear
- ◆ Silicone Sealant - D 174 003 A2-



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.*

Removing

- Remove the engine cover with air filter. Refer to [⇒ "4.1 Engine Cover with Air Filter", page 216](#).
- Remove the battery and the battery tray. Refer to ⇒ Electrical Equipment; Rep. Gr. 27 ; Battery, Removing and Installing; Vehicles with Gasoline Engine .

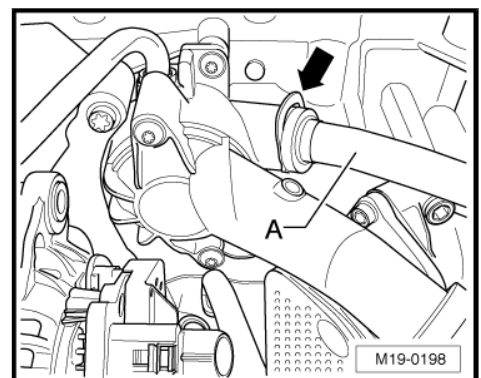


WARNING

Hot steam may escape when opening the reservoir.

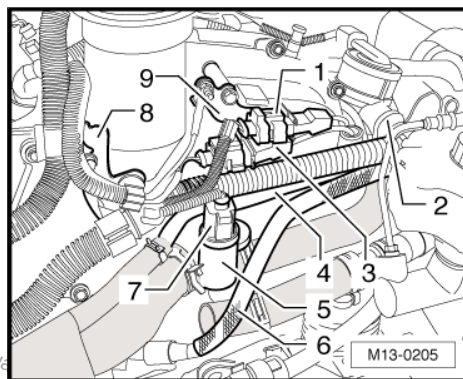
- ◆ *Wear protective eyewear and protective clothing to prevent eye injury and scalding.*
- ◆ *Cover the cap with a cloth and open very carefully.*

- Drain the coolant. Refer to [⇒ "4.1 Coolant, Draining and Filling", page 123](#) .
- Remove the intake manifold. Refer to [⇒ "4.3 Intake Manifold", page 218](#) .
- Remove the coolant pipe from the coolant distribution housing and from the bracket on the vacuum pump.
- Remove the clamp -arrow- and the coolant pipe -A-.



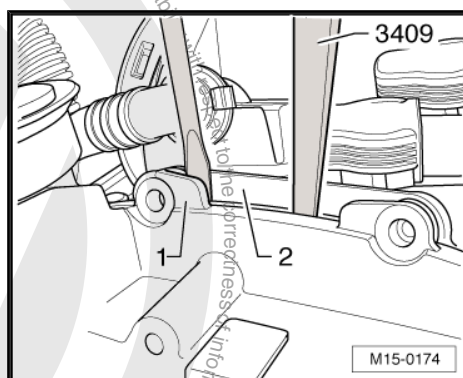


- Disconnect the connectors -1- and -3-.
- Remove the pressure pipe -2- from the secondary air injection solenoid valve.
- Remove the rear coolant pipe -4-.
- Remove the vacuum hose -6- from the vacuum pump and the connector -7-.
- Remove the bracket -8- and -9- and move the wiring harness with the pressure pipe to the side.
- Push the bracket for the knock sensor wiring harness on the secondary air injection solenoid valve slightly to the rear.
- Disconnect the coolant distribution housing -5- and move it to the side with the coolant hoses still connected.
- Remove all the bolts from the chain guard cover.
- Press the chain guard cover -1- off the cylinder head -2- at the openings at the top and bottom.



Note

- ◆ *Sealing surfaces must not be damaged under any circumstances. Use the Trim Removal Wedge - 3409- if necessary.*
- ◆ *After removing chain case cover, clean the Trim Removal Wedge - 3409- because it is intended for removal of interior equipment.*



Installing



WARNING

To prevent injuries from shavings, wear protective goggles and protective clothing.

- Remove remainder of sealant from the chain guard cover and from cylinder head for example using a rotating plastic brush.



Caution

Make sure that no sealant residue enters the engine.

- Clean the pipe connection on the cylinder head. If necessary, remove coolant deposits using a copper wire brush or fine sandpaper (minimum 100 grit). If the pipe connection is worn, replace it using Locking Fluid - D 000600 A2- .
- Replace the seal inside the chain guard cover. Refer to ➔ ["4.3 Chain Guard Cover Seal", page 73](#) .
- Replace the seal inside the coolant distribution housing.
- Clean the sealing surfaces, they must be free of oil and grease.

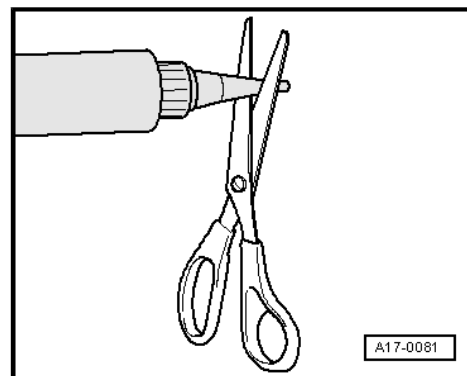


- Cut the tube nozzle at the front marking (nozzle diameter: approximately 1 mm).



Note

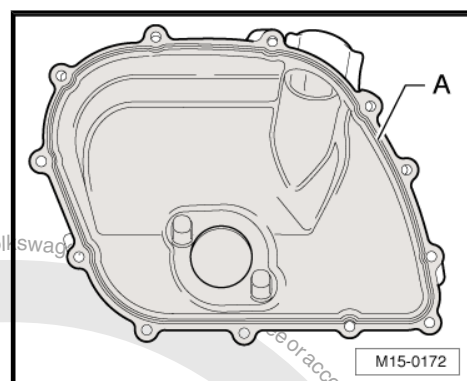
The chain guard cover must be installed within five minutes after applying the sealant.



- Apply a bead of sealant -A- to the clean sealing surface on the chain guard cover as illustrated.
- ◆ Sealant bead must be 1.5 to 2.0 mm thick.
- Coat chain guard cover seal lightly with engine oil and slide the chain guard cover onto the pipe connection.
- Install all the bolts and tighten them diagonally.

The rest of the installation follows the reverse of the removal procedures. Note the following:

- Fill the coolant. Refer to ⇒ ["4.1 Coolant, Draining and Filling", page 123](#).
- Install the battery. Refer to ⇒ Electrical Equipment; Rep. Gr. 27 ; Battery, Removing and Installing; Vehicles with Gasoline Engine .



Tightening specifications:

Component	Nm
Chain guard cover to cylinder head	10
Coolant distribution housing to chain guard cover	10

4.3 Chain Guard Cover Seal

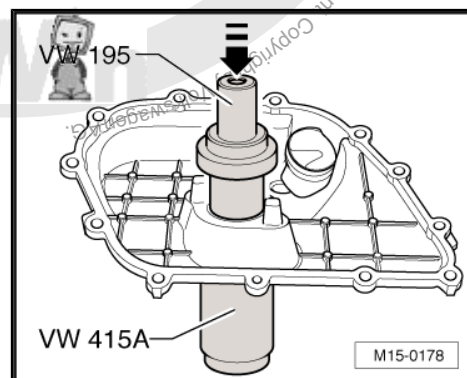
Special tools and workshop equipment required

- ◆ Seal Installer - Driveshaft - VW195-
- ◆ Press Piece - 60mm - VW415A-
- ◆ Seal Installer - Camshaft Installer Kit - Sleeve - 3241/4-

Conditions

- The chain guard cover is removed.

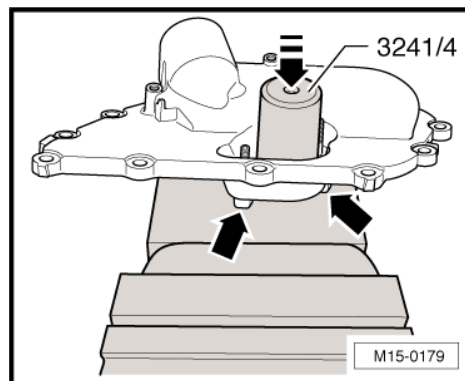
Removing the seal





Installing the seal

- Support the chain guard cover with the connections -arrows- on a secure backing and press in the new seal all the way.



4.4 Cylinder Head

Special tools and workshop equipment required

- ◆ Drip Tray - VAG1306- or Shop Crane - Drip Tray - VAS6208-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Hose Clip Pliers
- ◆ Polydrive Bit Drive Socket - T10070- or Polydrive Bit Drive Socket - 3452-
- ◆ Puller - Ignition Coil - T40039-
- ◆ Silicone Sealant - D 174 003 A2-



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ **Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.**
- ◆ **To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.**

Removing

- Drain the coolant. Refer to ⇒ [“4.1 Coolant, Draining and Filling” page 123](#) .
- Remove the engine cover with air filter. Refer to ⇒ [“4.1 Engine Cover with Air Filter”, page 216](#) .
- Remove the battery and the battery tray. Refer to ⇒ Electrical Equipment; Rep. Gr. 27 ; Battery, Removing and Installing; Vehicles with Gasoline Engine .



WARNING

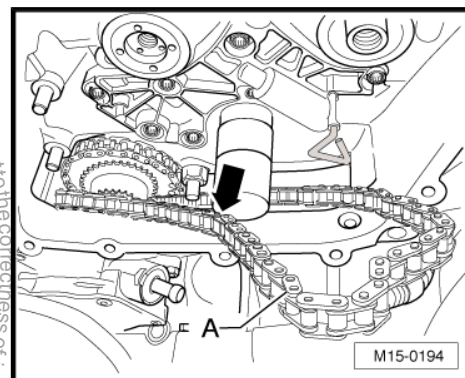
Hot steam may escape when opening the reservoir.

- ◆ **Wear protective eyewear and protective clothing to prevent eye injury and scalding.**
- ◆ **Cover the cap with a cloth and open very carefully.**



- Remove the intake manifold. Refer to
 ⇒ [“4.3 Intake Manifold”, page 218](#) .
- install the transport strap again on the cylinder head in order
 to better hold the cylinder head during removal.
- Remove the chain guard cover. Refer to
 ⇒ [“4.2 Chain Guard Cover”, page 71](#) .
- Remove the cylinder head cover. Refer to
 ⇒ [“4.1 Cylinder Head Cover”, page 70](#) .
- Lock the camshafts and remove the camshaft chain sprockets
 (refer to ⇒ [“3.2 Valve Timing, Adjusting”, page 64](#) adjusting
 valve timing).

Hold the timing chain -A- as illustrated so that it can be routed
 below the pipe connection -arrow-.

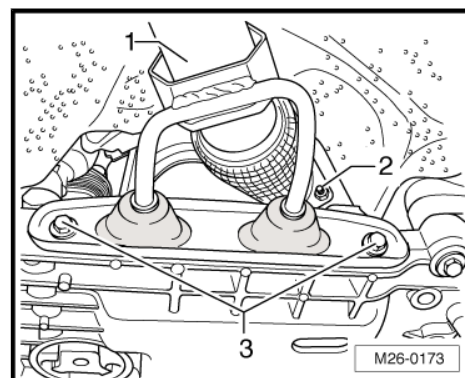


- Remove the four nuts -2- and the bolts -3-.
- Remove the front exhaust pipe -1- from the exhaust manifold
 and tie it to the side. Refer to
 ⇒ [“4.1 Front Exhaust Pipe with Catalytic Converter, Removing
 and Installing”, page 246](#) .

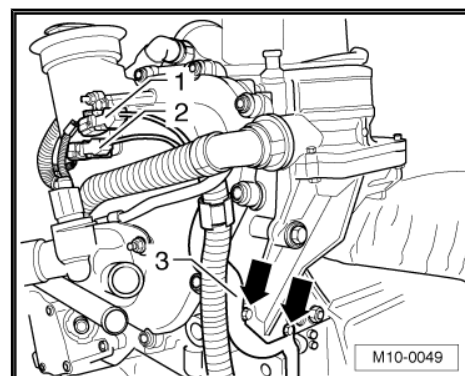


Note

*Flex joint in front exhaust pipe must not be bent more than 10 °,
 otherwise it may be damaged.*



- Disconnect the connector for Heated Oxygen Sensor - G39-
 at the bulkhead.
- Remove the cable holder -3- from the air injection valve or
 cover (engines without secondary air injection system)
 -arrows-.





- Remove the cylinder head bolts in the specified sequence.



Note

- ♦ If the bolt -2- was not able to be pulled out using a magnet, loosen bolts of Camshaft Clamp - T40070- one rotation, slide the Camshaft Clamp - T40070- toward the front at right (seen in direction of travel) and tighten the bolts again.
- ♦ A second technician will be needed to remove and install the cylinder head.

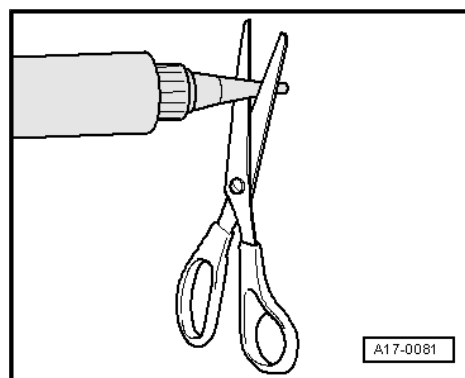
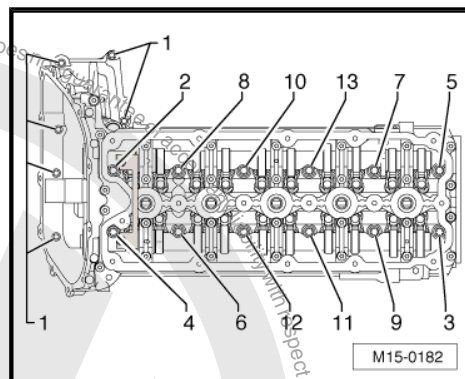
- Carefully remove cylinder head.

Installing



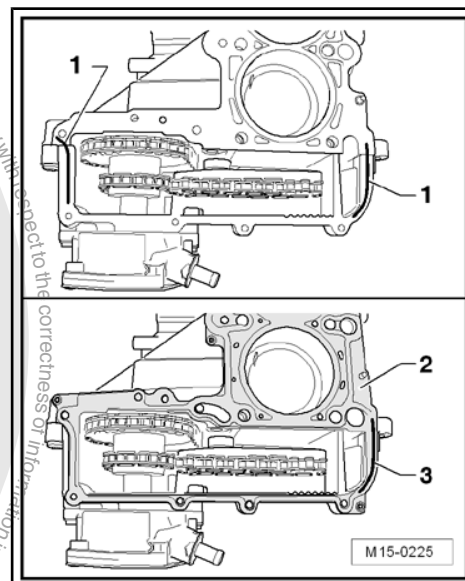
Note

- ♦ There must be no oil or coolant in the blind holes for the cylinder head bolts in the cylinder block.
 - ♦ Only remove the new cylinder head gasket from its packing immediately before installing.
 - ♦ Handle the new gasket with extreme care. Damaging will lead to leaks.
 - ♦ Replace the cylinder head bolts.
 - Stuff clean cloths into cylinders and chain compartment so that no dirt or abrasive powder can penetrate between cylinder wall and piston and into chain compartment.
 - Do not allow dirt or abrasive powder to get into coolant either.
 - Carefully clean the cylinder head and cylinder block sealing surfaces. Avoid introducing scratches or scoring (do not use sandpaper with grit below 100).
 - Carefully remove metal particles, emery remains and cloths.
 - Cut the tube nozzle at the front marking (nozzle diameter: approximately 1 mm).
- Note shelf-life date.

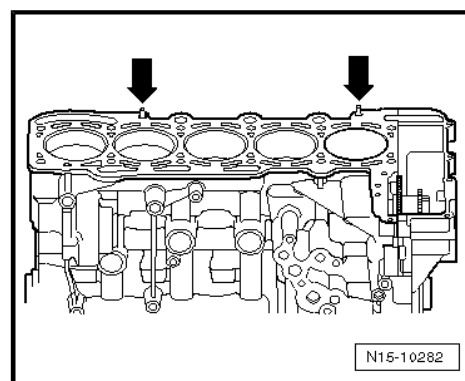




- Apply a bead of sealant -1- (front and rear) on the clean sealing surfaces as illustrated.
- ◆ The sealant bead must be 2.0 to 2.5 mm thick.
- Install the new cylinder head gasket -2-.



- Pay attention to the centering pins on the cylinder block -arrows-.



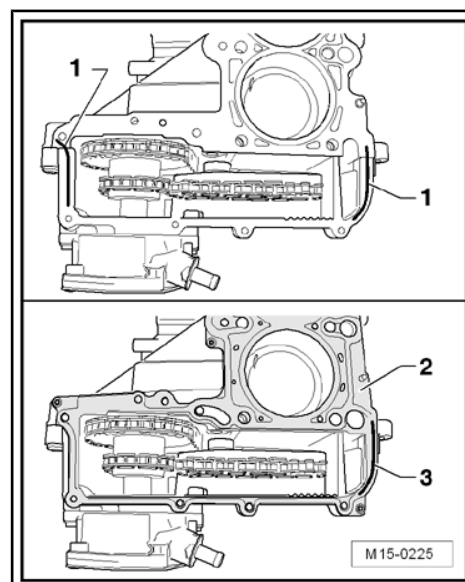
- Apply a bead of sealant -3- (rear only), as illustrated, on the cylinder head seal.
- ◆ The sealant bead must be 2.0 to 2.5 mm thick.



Note

The cylinder head must be installed within 5 minutes of being applied with sealant.

- Install cylinder head.
- Guide the timing chain over the pipe connection.
- Insert cylinder head bolts and tighten them hand-tight.





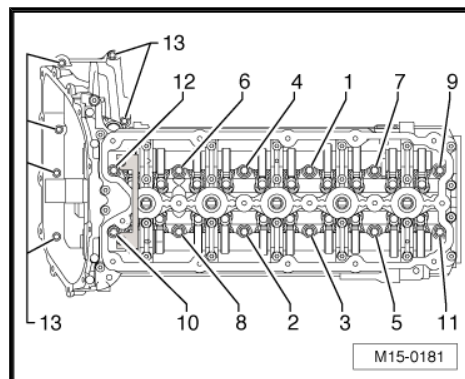
- Tighten the cylinder head bolts -1 through 12- in the following:

Step	Tighten
1	– Using torque wrench, tighten to 40 Nm.
2	– With a rigid wrench, 90° (1/4 turn) additional turn.
3	– With a rigid wrench, 90° (1/4 turn) additional turn.

- Tighten the bolt -13- to 10 Nm.
- Wipe off any sealant, which has leaked out.

The rest of the installation follows the reverse of the removal procedures. Note the following:

- ◆ Remove the Crankshaft Locking Pin - T40069- from the back of the cylinder block and install the bolt.
- ◆ Install the battery. Refer to ➔ Electrical Equipment; Rep. Gr. 27 ; Battery, Removing and Installing; Vehicles with Gasoline Engine .
- ◆ Drain and fill the coolant. Refer to ➔ [“4.1 Coolant, Draining and Filling”, page 123](#) .



4.5 Valve Stem Seals

Special tools and workshop equipment required

- ◆ Spark Plug Removal Tool - 3122B-
- ◆ Puller - Valve Seal - 3364-
- ◆ Seal Installer - Valve Stem - 3365-
- ◆ Valve Cotter Tool Kit - Adapter - T40012-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Valve Keeper Tool Kit - VAS5161A-
- ◆ Valve Cotter Tool Kit - Guide Plate 19C - VAS5161/19C-

(with cylinder head installed)

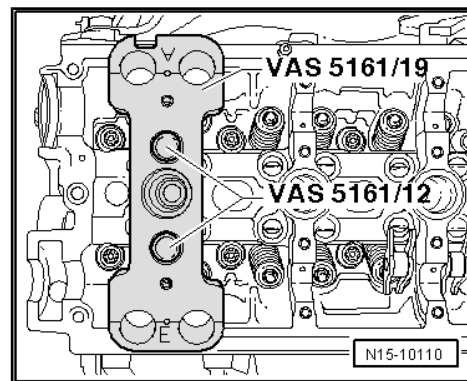
Removing

To remove valve stem seals, the following valves must be removed as follows:

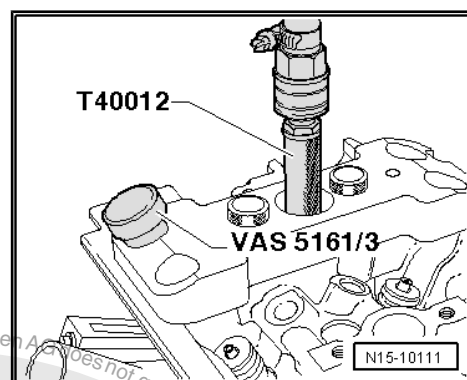
- ◆ Intake valves cylinder 1: transport strap
- ◆ Intake valves cylinder 5: Camshaft Adjustment Valve 1 - N205-
- ◆ Exhaust valves cylinder 5: Secondary Air Injection Solenoid Valve - N112-
- Remove the camshafts. Refer to ➔ [“4.6 Camshafts”, page 81](#) .
- Remove the roller rocker levers and lay them on a clean surface. Make sure that roller cam followers are not interchanged.
- Remove the spark plugs using the Spark Plug Removal Tool - 3122B- .



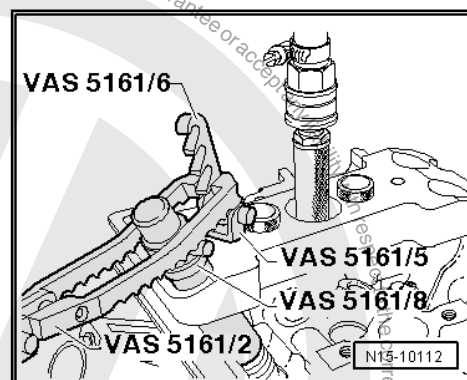
- Fasten the Valve Cotter Tool Kit - Guide Plate 19C - VAS5161/19C- with the Valve Cotter Tool Kit - Knurled Thumb Screws M6 - VAS5161/12- onto the cylinder head as shown.
- Adjust the piston of the respective cylinder to “bottom dead center”.
- Install the Valve Cotter Tool Kit - Adapter - T40012- into the spark plug thread and connect the compressed air of at least 6 bar pressure.



- Loosen the secure fitting valve keepers using the Punch - VAS5161/3A- and a plastic mallet.



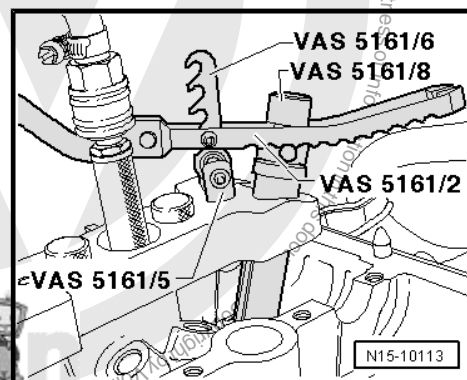
- Install the Valve Cotter Tool Kit - Retainer - VAS5161/6- using the Valve Cotter Tool Kit - Guide Forks M6/M8 Threaded - VAS5161/5- into the Valve Cotter Tool Kit - Guide Plate 19B - VAS5161/19B- .
- Place the Valve Cotter Tool Kit - Assembly Cartridge - VAS5161/8A- in the Valve Cotter Tool Kit - Guide Plate 19C - VAS5161/19C- .
- Engage the Valve Cotter Tool Kit - Pressure Fork with Lever for Assembly Cartridge - VAS5161/2- on the Valve Cotter Tool Kit - Retainer - VAS5161/6- .



Note

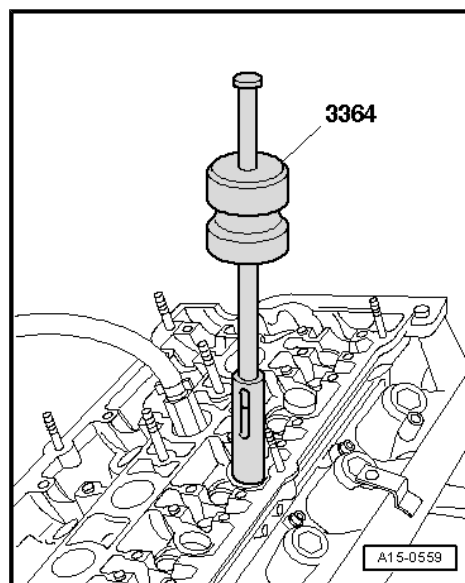
The Valve Cotter Tool Kit - Pressure Fork with lever for Assembly Cartridge - VAS5161/2- must engage on the exhaust side as illustrated.

- Press the Valve Cotter Tool Kit - Assembly Cartridge - VAS5161/8A- downward. At the same time, turn the knurled screw of the Valve Cotter Tool Kit - Assembly Cartridge - VAS5161/8A- to the right, until the points engage in the valve keepers.
- Lightly move knurled bolt of installation cartridge back and forth, this causes the valve retainers to be pressed apart and captured in the installation cartridge.
- Release the Valve Cotter Tool Kit - Pressure Fork with Lever for Assembly Cartridge - VAS5161/2- .
- Remove the Valve Cotter Tool Kit - Assembly Cartridge - VAS5161/8- , valve spring retainers and valve springs.

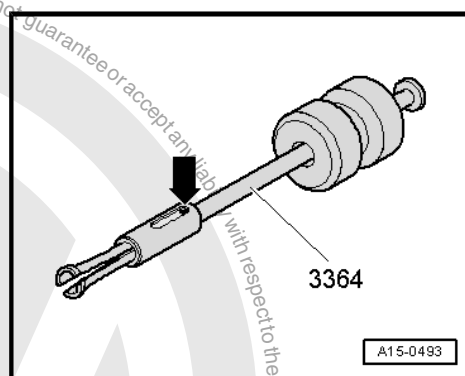




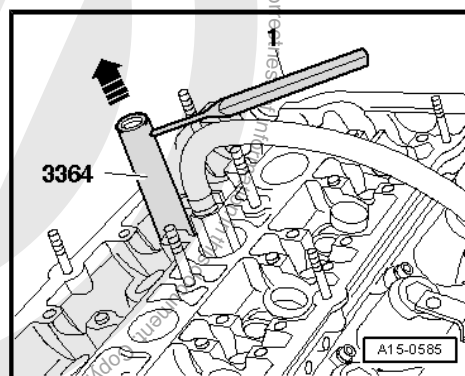
- Remove the valve stem seals using Puller - Valve Seal - 3364- .



- If there is not enough room to use the Puller - Valve Seal - 3364- , drive out the spring dowel sleeve -arrow- using a drift and the remove impact device.

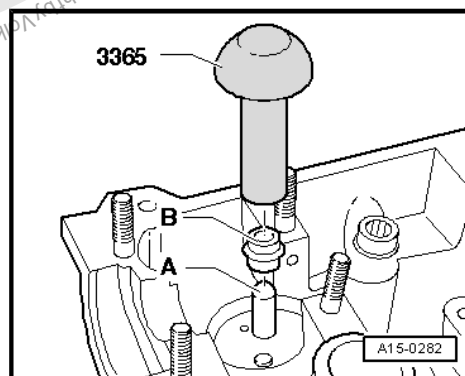


- Place the lower section of the Valve Seal Removal Tool - 3364- on the valve stem seal.
- Install a drift -1- into the hole into the lower part of the removal tool.
- Position a lever at assembly device and pull out valve stem seal -arrow-.



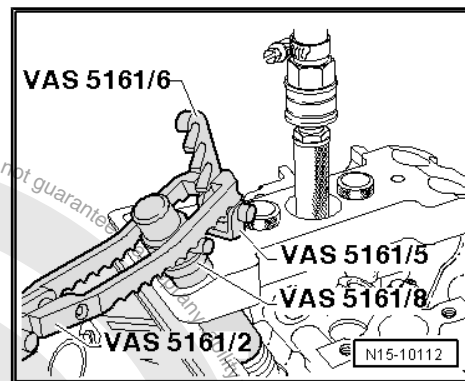
Installing

- Place plastic sleeve -A- on valve stem to prevent damage to new valve stem seals -B-.
- Oil the sealing lip of valve stem seal -B-, insert into Seal Installer - Valve Stem - 3365- and carefully slide onto the valve guide.
- Remove the plastic sleeve -A-.
- Insert valve spring and valve spring retainer.
- Install the Valve Cotter Tool Kit - VAS5161- as shown.

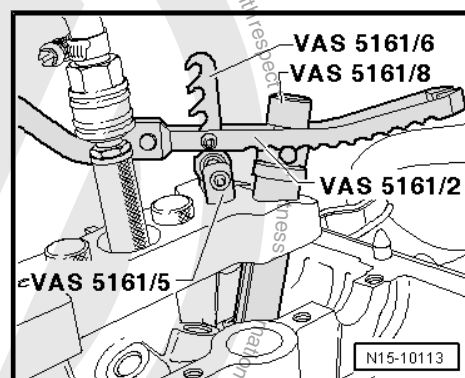




Intake side



Exhaust side

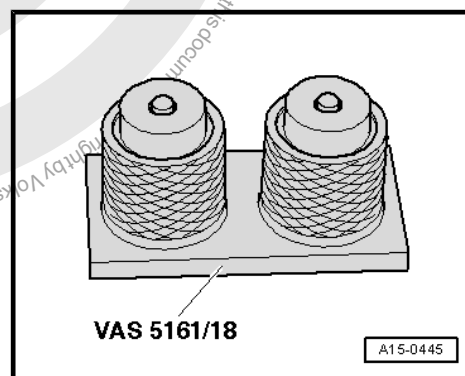


Note

- ◆ If the valve keepers were removed from the assembly cartridge, they must then be inserted into the Valve Insertion Device - VAS5161/18- .
- ◆ Press the Valve Cotter Tool Kit - Assembly Cartridge - VAS5161/8A- onto the insertion device from above and capture the valve retainers.
- Press down Valve Cotter Tool Kit - Assembly Cartridge - VAS5161/8- using Valve Cotter Tool Kit - Pressure Fork with Lever for Assembly Cartridge - VAS5161/2- , lightly tap against the lower part of the installation cartridge, rotate the installation cartridge knurled bolt back and forth and pull upward at the same time.
- Release the Valve Cotter Tool Kit - Pressure Fork with Lever for Assembly Cartridge - VAS5161/2- with the knurled screw pulled.
- Remove the Valve Cotter Tool Kit - VAS5161- .

The rest of the installation follows the reverse of the removal procedures. Note the following:

- ◆ Remove the Crankshaft Locking Pin - T40069- from the back of the cylinder block and install the bolt.
- ◆ Fill the coolant. Refer to [⇒ "4.1 Coolant, Draining and Filling", page 123](#) .



4.6 Camshafts

Special tools and workshop equipment required

- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Hand Drill With Plastic Brush Attachment



- ◆ Protective eyewear
- ◆ Sealant - D 154 103 A1-

Removing



Note

- ◆ *Sealing surfaces on guide frame at bottom and on cylinder head at top must not be worked.*
- ◆ *Camshaft bearings are integrated in cylinder head or in guide frame. Before removing guide frame, chain sprockets of camshafts must be removed.*
- ◆ *If guide frame was loosened, sealing plugs must be replaced.*
- Lock the camshafts and remove the chain sprockets from the camshafts. Refer to
⇒ [“3.2 Valve Timing, Adjusting”, page 64](#) .
- Remove the Camshaft Clamp - T40070- .
- Remove the bolts from the guide frame evenly from outside toward inside and then remove the guide frame.
- Carefully remove camshaft upward and place on a clean surface.

Installing



WARNING

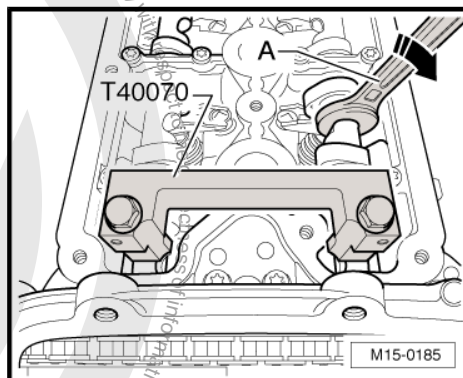
To prevent injuries from shavings, wear protective goggles and protective clothing.

- Remove remainder of sealant from guide frame (out of grooves as well) and from cylinder head for example using a rotating plastic brush.



Caution

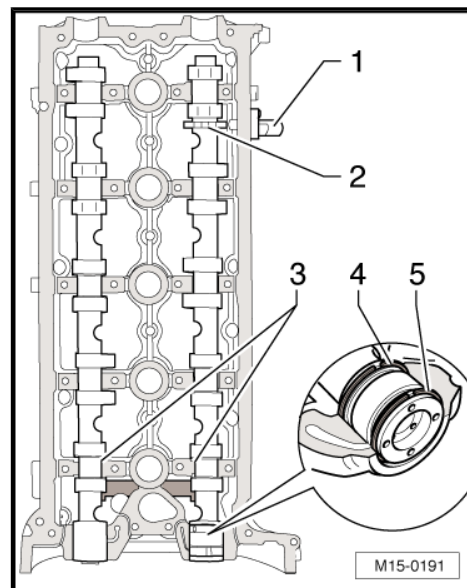
Make sure that no sealant residue enters the engine.



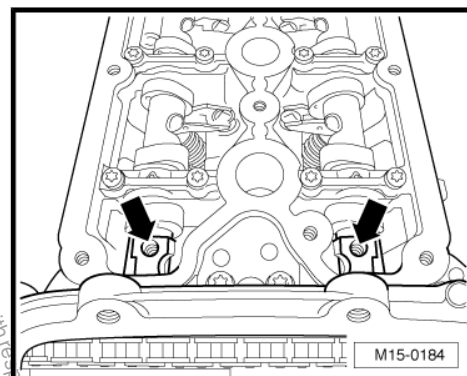
- Clean the sealing surfaces, they must be free of oil and grease.
- Oil journal surfaces of camshafts.
- Place guide frame on a soft surface.



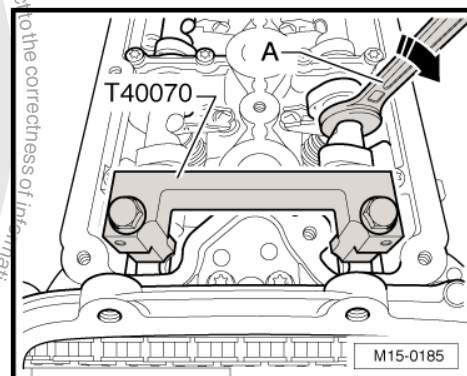
- Insert camshafts correctly into guide frame.
- ◆ The intake camshaft with sensor wheel -2- points toward the Camshaft Position Sensor - G40- -1-.
- ◆ Camshafts must lie exactly in the axial bearings -3- of guide frame.
- ◆ Sealing ring ends -4- and -5- must point upward or downward, they must not point to the side under any circumstances.
- Turn around guide frame with inserted camshafts slightly, hold camshafts firmly in place in guide frame while doing this.



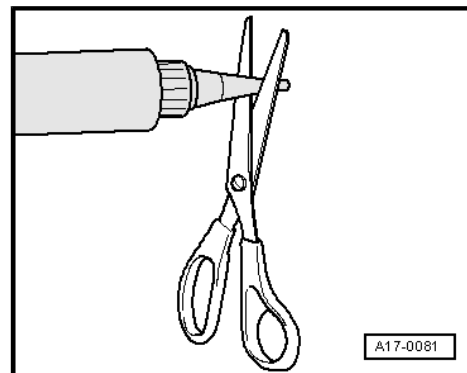
- Rotate the camshafts until the threaded hole -arrows- face upward.
- Check whether camshafts still lie exactly in axial bearings of guide frame.



- Screw the Camshaft Clamp - T40070- onto the camshafts, as shown, and tighten the bolts to 20 Nm.
- Turn around guide frame again.



- Cut the tube nozzle at the front marking (nozzle diameter: approximately 1 mm).





- Lightly apply an even bead of sealant into the clean grooves of the guide frame -1 to 8-.

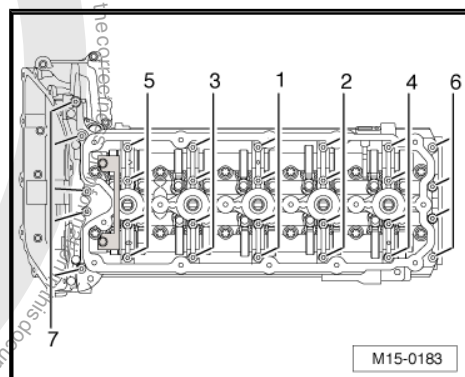
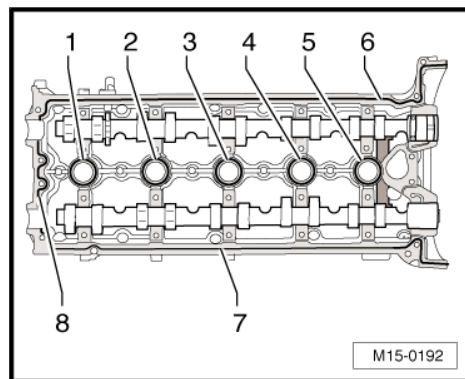
Width of sealant bead:

- ◆ Grooves -1 through 5-: approximately 3.0 mm
- ◆ Grooved -6 to 8-: approximately 4.0 mm

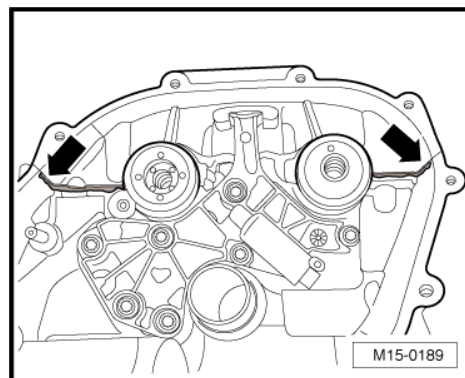


Note

- ◆ *Sealant beads must be applied according to exact specifications, otherwise excess sealant could get into the camshaft bearings.*
- ◆ *Attaching and bolting the guide frame should be performed without interruption because the sealant begins to harden immediately as soon as it contacts the sealing surfaces.*
- ◆ *Note the expiration date of the sealing compound.*
- Attach guide frame on cylinder head immediately.
- Gently tighten bolts from inside working toward outside in several stages.
- Then tighten bolts to 8 Nm in the sequence indicated.
- Tighten all the bolts an additional 90° (1/4 turn).



- The sealant must be squeezed out slightly, even in the area of the chain chamber -arrows-.
- Wipe the sealant off of the sealing surface for the chain guard cover.





- Carefully press in the sealing plugs -A- up to the end of the chamfer -arrows-.

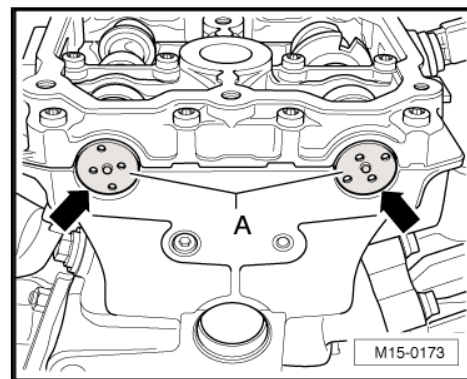


Note

If sealing plug was pressed in too far, it must be pressed through and pressed in anew up to the marking.

The rest of the installation follows the reverse of the removal procedures. Note the following:

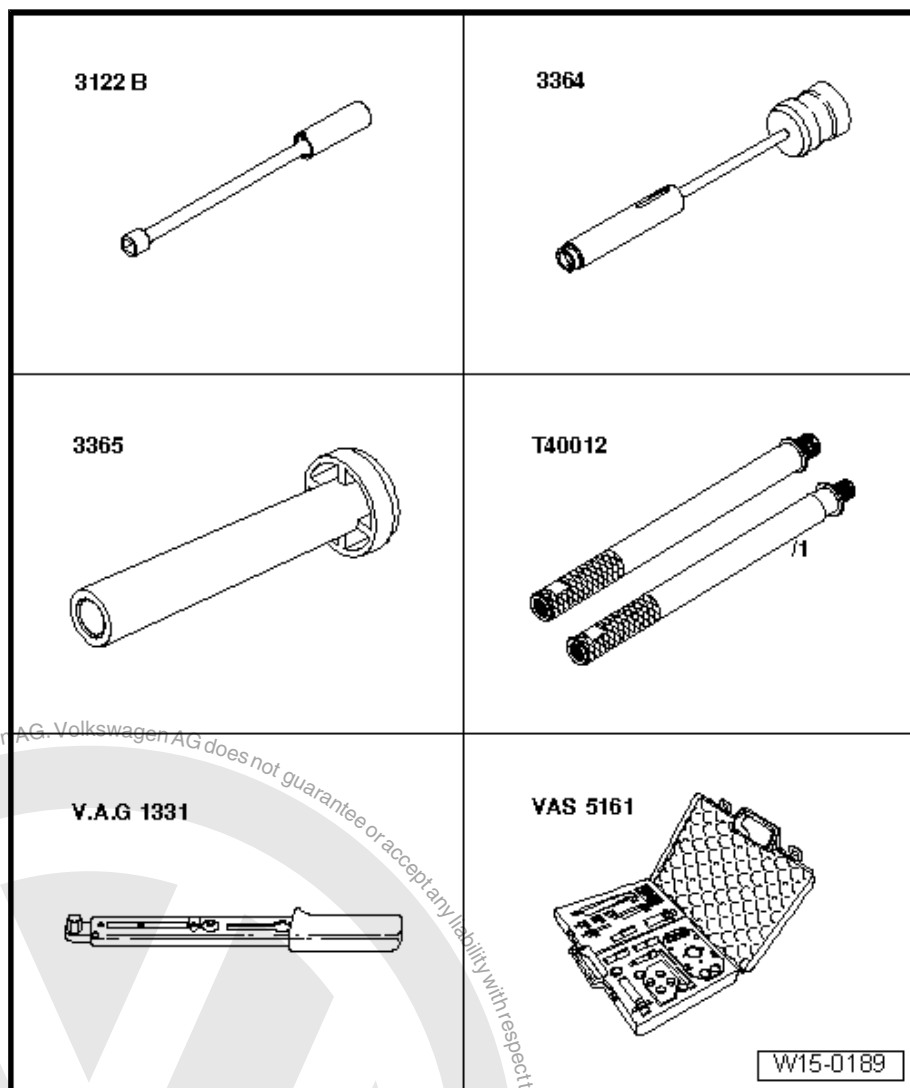
- ◆ Remove the Crankshaft Locking Pin - T40069- from the cylinder block at the rear and install the plug (30 Nm).
- ◆ Fill the coolant. Refer to
[⇒ "4.1 Coolant, Draining and Filling", page 123](#) .





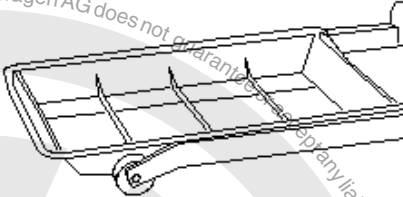


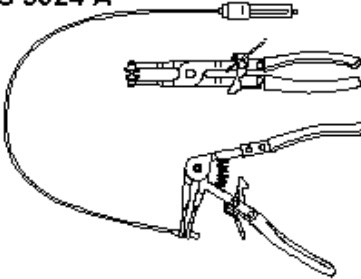
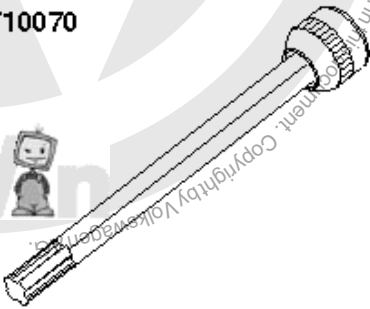
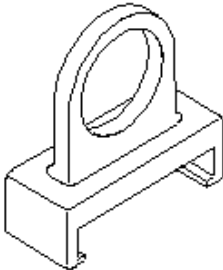
5 Special Tools

Special tools and workshop equipment required

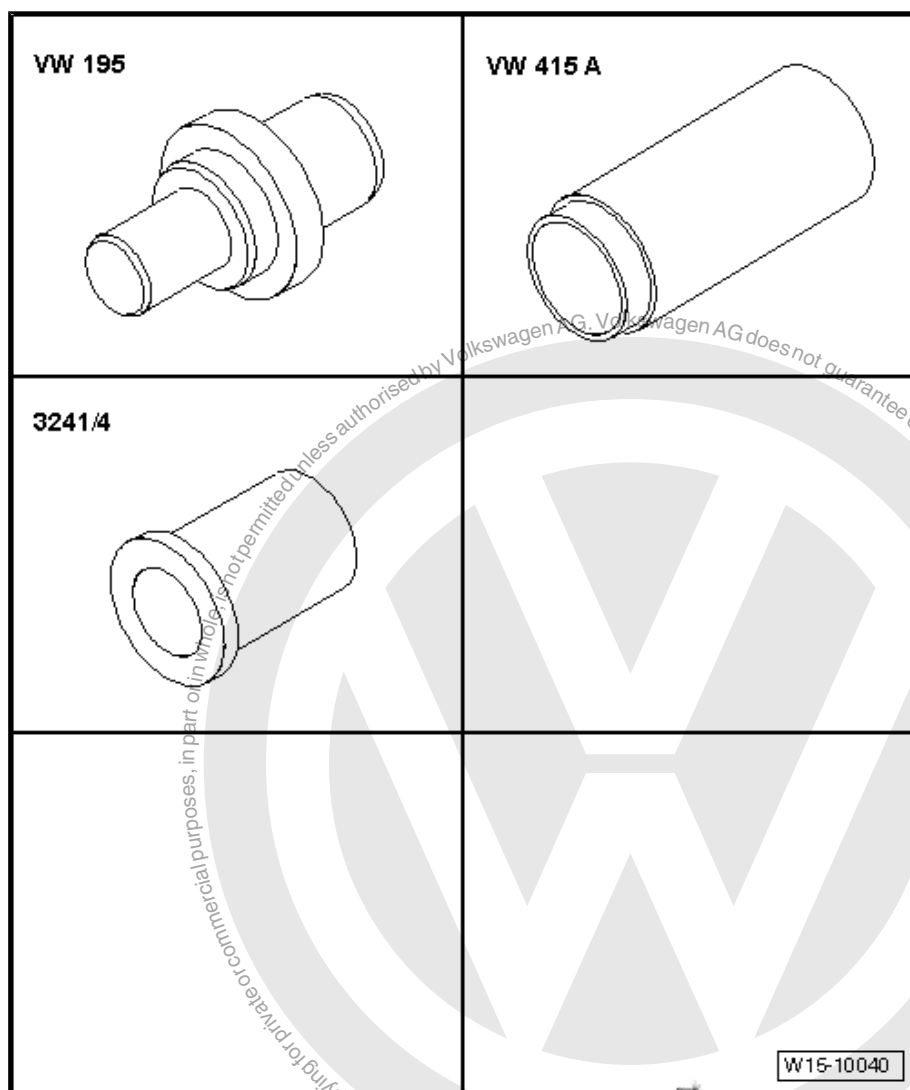


- ◆ Spark Plug Removal Tool - 3122B-
- ◆ Puller - Valve Seal - 3364-
- ◆ Seal Installer - Valve Stem - 3365-
- ◆ Valve Cotter Tool Kit - Adapter - T40012-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Valve Keeper Tool Kit - VAS5161A-
- ◆ Valve Cotter Tool Kit - Guide Plate 19C - VAS5161/19C-

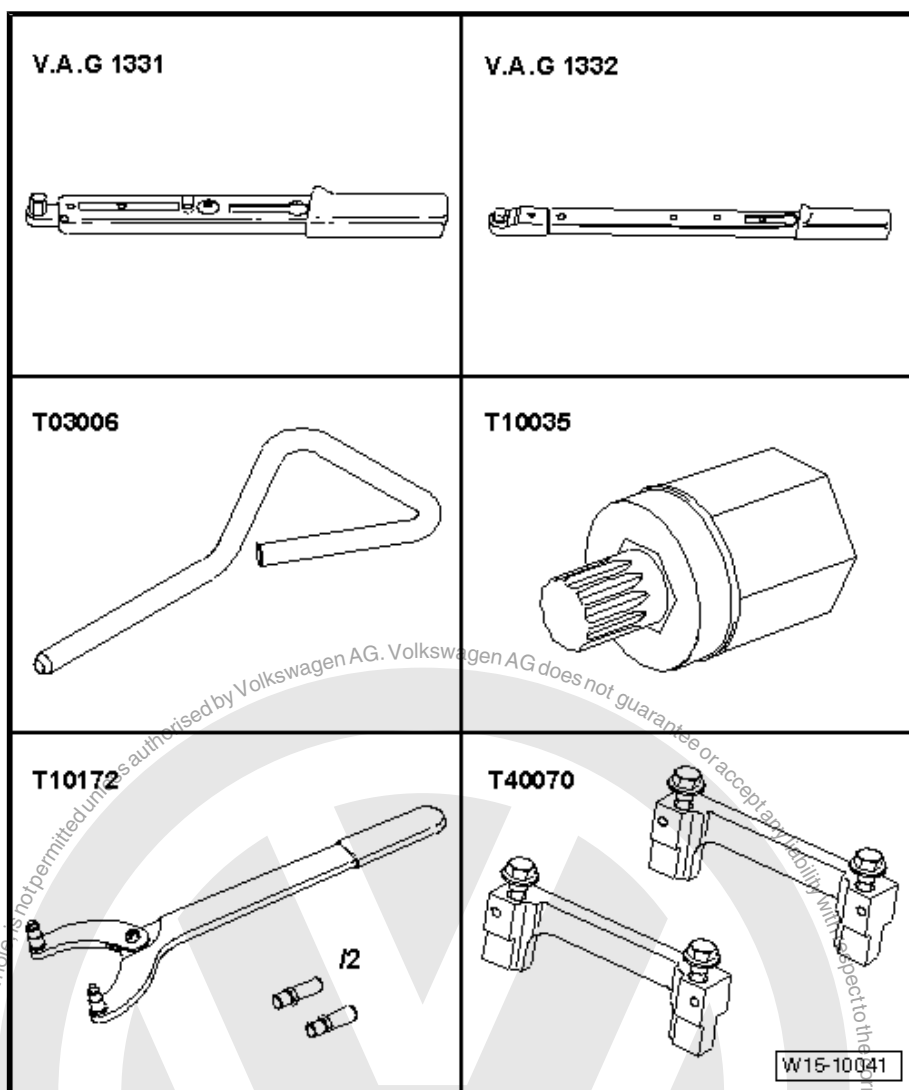


<p>V.A.G 1306</p> 	<p>V.A.G 1331</p> 
<p>V.A.G 1332</p> 	<p>VAS 5024 A</p> 
<p>T10070</p> 	<p>T40039</p>  <p>WV15-10004</p>

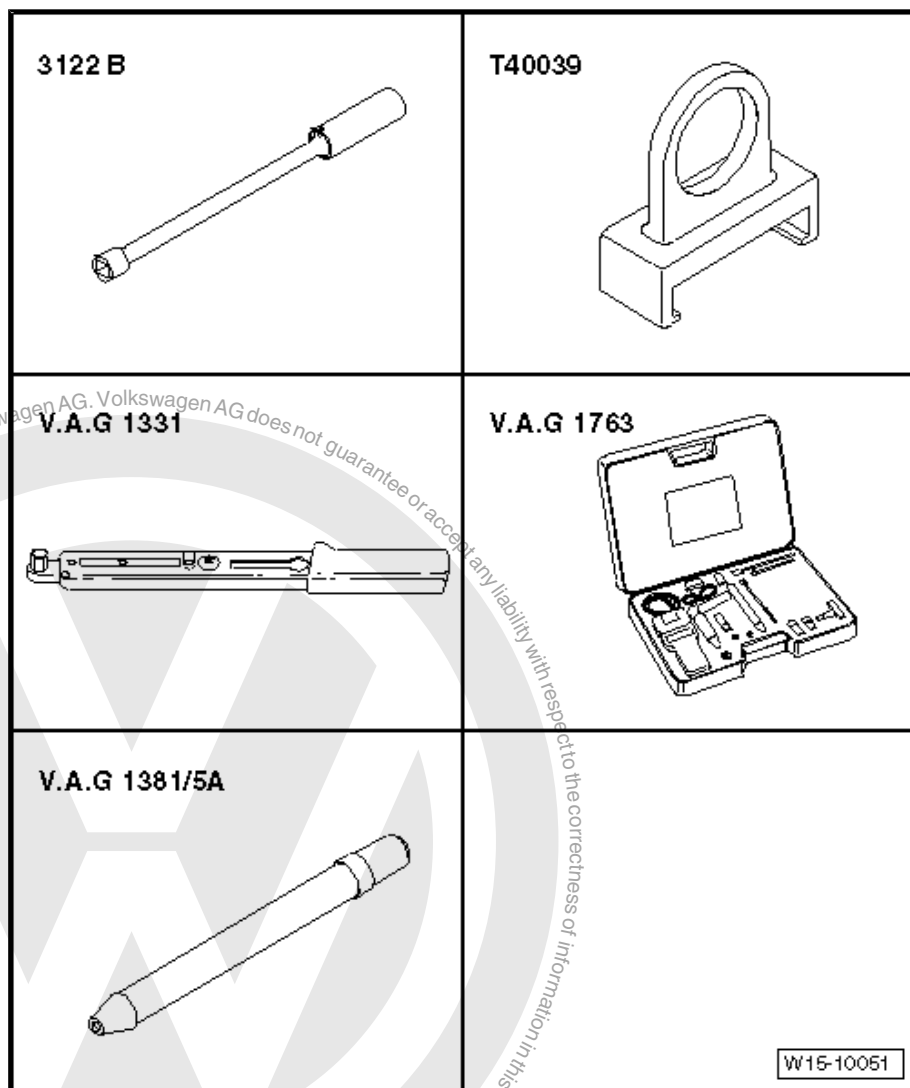
- ◆ Drip Tray - VAG1306- or Shop Crane - Drip Tray - VAS6208-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Hose Clip Pliers - VAS5024A-
- ◆ Polydrive Bit Drive Socket - T10070- or Polydrive Bit Drive Socket - 3452-
- ◆ Puller - Ignition Coil - T40039-



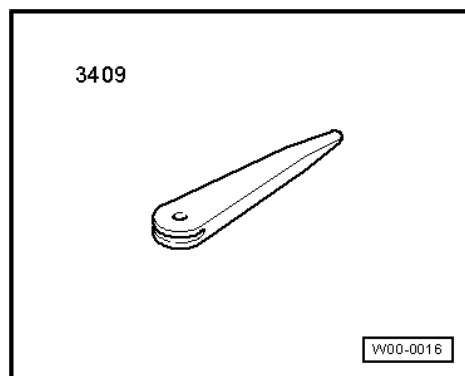
- ◆ Seal Installer - Driveshaft - VW195-
- ◆ Press Piece - 60mm - VW415A-
- ◆ Seal Installer - Camshaft Installer Kit - Sleeve - 3241/4-



- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Locking Pins - T03006-
- ◆ Multipoint Socket - T10035-
- ◆ Counterhold - Kit - Multiple Use T10172-
- ◆ Camshaft Clamp - T40070-



- ◆ Spark Plug Removal Tool - 3122B-
- ◆ Puller - Ignition Coil - T40039-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Compression Tester Kit - VAG1763-
- ◆ Compression Tester Kit - Adapter 5A - VAG1381/5A-
- ◆ Trim Removal Wedge - 3409-





17 – Lubrication

1 General Information

⇒ [“1.1 Lubrication System Components”, page 91](#)

⇒ [“1.2 Engine Oil”, page 91](#)

1.1 Lubrication System Components



Note

- ◆ *If large quantities of metal particles or abraded material are detected during engine repairs, it may mean the crankshaft or rod bearings are damaged. To prevent further damage, perform the following steps after the repair:*
- ◆ *Clean the oil channels carefully.*
- ◆ *Replace the oil spray jets.*
- ◆ *Replace the oil cooler.*
- ◆ *Replace the oil filter.*
- ◆ *The oil level must not go above the MAX mark - danger of causing damage to the catalytic converter!*

1.2 Engine Oil

Oil Capacities

Oil Capacities

With a oil filter change: Refer to ⇒ Fluid Capacity Tables; Rep. Gr. 03 .

Without a oil filter change: Refer to ⇒ Fluid Capacity Tables; Rep. Gr. 03 .

If necessary, fill to the MAX mark on the oil dipstick. Refer to ⇒ [Fig. “Oil Dipstick Markings”, page 91](#) .

Viscosity classes and oil specifications

Refer to the ⇒ Maintenance ; Booklet 20.1 “Maintenance Tables”.

Oil Dipstick Markings

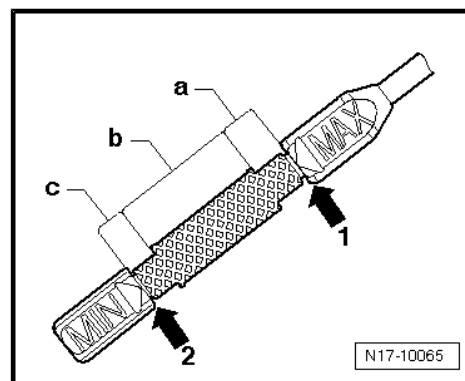
1 - MAX marking

2 - MIN marking

a - Oil level is near the MAX mark: do not add oil!

b - Oil level in the center: engine oil can be filled.

c - Oil level is near the MIN mark: fill with approximately 0.5 liters of oil!





2 Description and Operation

⇒ [“2.1 Overview - Lubrication System Components”, page 92](#)

⇒ [“2.2 Overview - Oil Filter Bracket with Attachments”, page 94](#)

2.1 Overview - Lubrication System Components

1 - Cylinder Block

2 - Power Take-Off Drive Chain

- ❑ Beginning with MY 2008 the roller chain has been changed to a tooth chain.

3 - Bolt

- ❑ 20 Nm + 90° (1/4) additional turn
- ❑ Replace

4 - Bolt

- ❑ 25 Nm

5 - Oil Filter Bracket with Attachments

- ❑ Overview. Refer to ⇒ [“2.2 Overview - Oil Filter Bracket with Attachments”, page 94](#).

6 - Chain Sprocket for Oil Pump

- ❑ Removing and installing
- ◆ Engine codes BGP, BGQ and BTK. Refer to ⇒ [“4.4 Oil Pump”, page 103](#).
- ◆ Engine codes CBTA, CBUA and CCCA. Refer to ⇒ [“4.5 Oil Pump”, page 106](#).
- ❑ The letters face outward
- ❑ With anti-twist mechanism

7 - Oil Pump

- ❑ Removing and installing
- ◆ Engine codes BGP, BGQ and BTK. Refer to ⇒ [“4.4 Oil Pump”, page 103](#).
- ◆ Engine codes CBTA, CBUA and CCCA. Refer to ⇒ [“4.5 Oil Pump”, page 106](#).

8 - Bolt

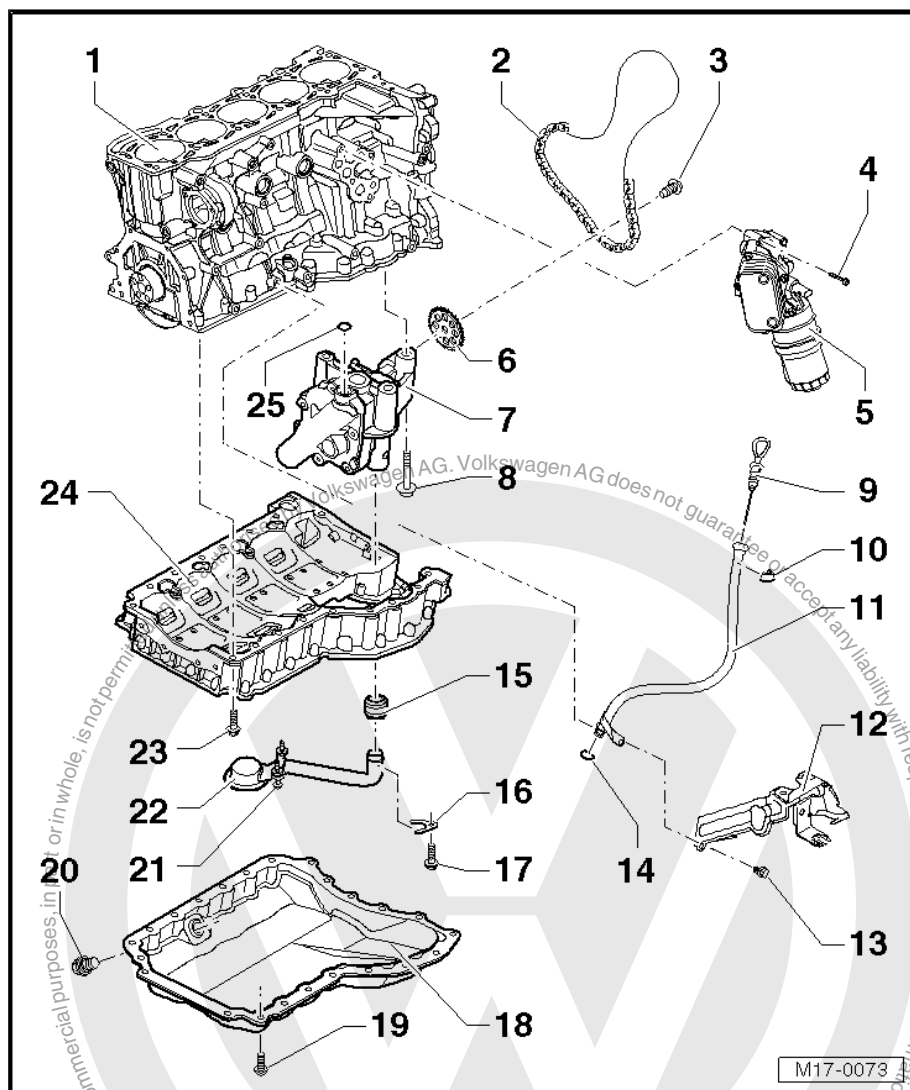
- ❑ 25 Nm

9 - Oil Dipstick

- ❑ Oil level must not be above the max. mark!

10 - Retaining Ring

- ❑ Clipped in intake manifold





11 - Guide Tube

12 - Intake Manifold Support

- ☐ Only for engines with the secondary air injection system

13 - Bolt

- ☐ 25 Nm

14 - O-Ring

- ☐ Replace

15 - Seal

- ☐ Replace

16 - Mount

17 - Bolt

- ☐ 10 Nm

18 - Oil Pan Lower Section

- ☐ Removing and installing. Refer to ➤ [“4.2 Oil Pan Lower Section”, page 98](#) .

19 - Bolt

- ☐ 10 Nm

20 - Oil Drain Plug, 30 Nm

- ☐ Replace

21 - Decoupling Element

- ☐ 10 Nm
- ☐ Bolt

22 - Oil Intake Pipe

23 - Bolt

- ☐ 25 Nm

24 - Oil Pan Upper Section

- ☐ Removing and installing. Refer to ➤ [“4.3 Oil Pan Upper Section”, page 100](#) .

25 - O-Ring

- ☐ Replace

2.2 Overview - Oil Filter Bracket with Attachments

1 - Bolt

- ☐ 25 Nm

2 - Oil Filter Bracket

- ☐ Removing:
 - Drain the coolant. Refer to [⇒ "4.1 Coolant, Draining and Filling", page 123](#) .
 - Remove the intake manifold. Refer to [⇒ "4.3 Intake Manifold", page 218](#) .
 - Remove the connection for the thermostat.
 - Disconnect coolant hose from thermostat housing.
 - Drain the oil filter housing and remove it. Refer to [⇒ "4.1 Oil Filter Housing, Draining", page 98](#) .
 - Loosen intake manifold support.
 - Remove the oil filter bracket. The bleeder hose remains connected -item 6- [⇒ Item 6 \(page 94\)](#) .

3 - Seal

- ☐ Replace

4 - Oil Pressure Switch - F1-

- ☐ Tightening specification: 20 Nm
- ☐ 1.4 bar, black
- ☐ Checking. Refer to [⇒ "3.1 Oil Pressure and Oil Pressure Switch, Checking", page 96](#) .

5 - From Intake Hose

- ☐ -item 3- [⇒ Item 3 \(page 206\)](#)

6 - Vent Hose

- ☐ Because of 4-pin retainer, disconnect only when oil filter is removed

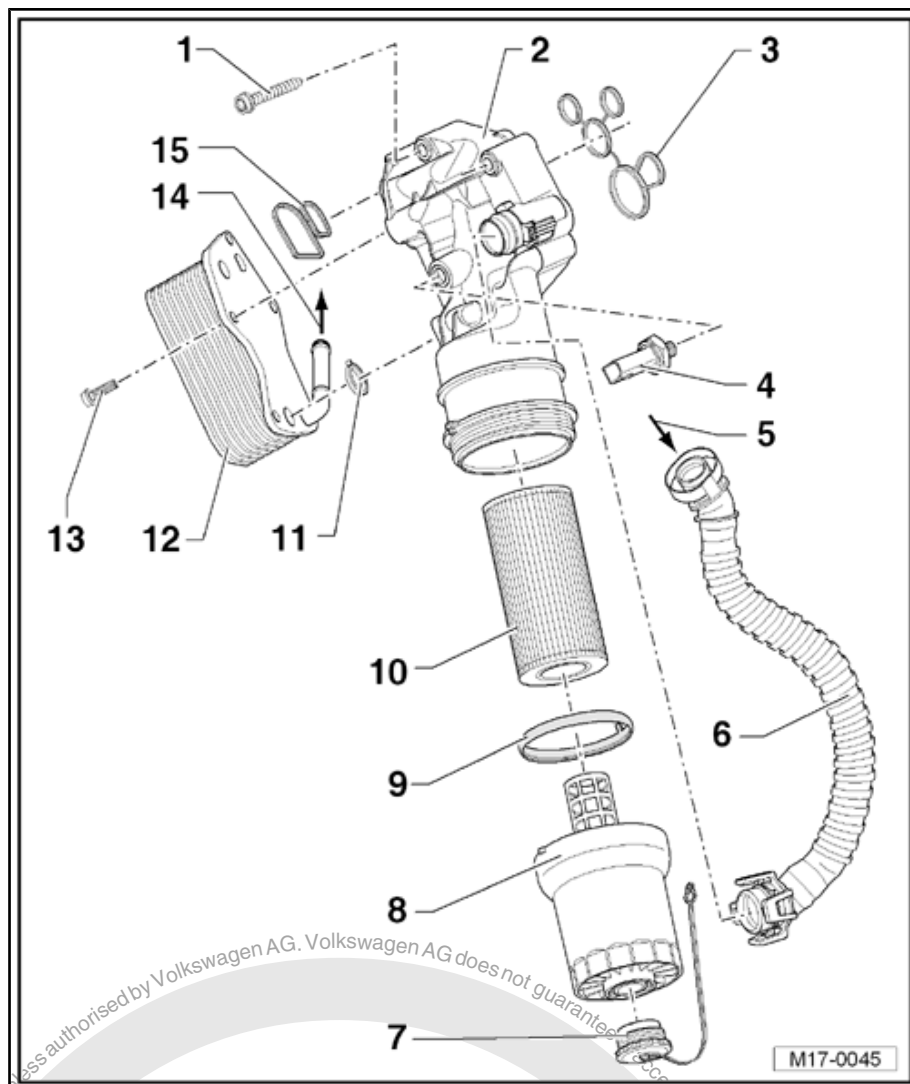
7 - Dust Cap

8 - Oil Filter Housing

- ☐ 25 Nm
- ☐ Remove and install using the Wrench - Oil Filter - 3417-
- ☐ Draining. Refer to [⇒ "4.1 Oil Filter Housing, Draining", page 98](#) .

9 - Seal

- ☐ No replacement part, part of the oil filter
- ☐ Insert when oiled
- ☐ Installed position: position indicator at the top





10 - Oil Filter

- ☐ Drain the oil filter housing before removing the oil filter. Refer to
⇒ [“4.1 Oil Filter Housing, Draining”, page 98](#) .
- ☐ replace ⇒ Maintenance ; Booklet 20.1 “Engine oil: drain or extract”

11 - Seal

- ☐ Replace

12 - Oil Cooler

- ☐ See note. Refer to ⇒ [“1.1 Lubrication System Components”, page 91](#) .
- ☐ Make sure there is enough space to the surrounding components
- ☐ Coolant Hose Connection Diagram. Refer to ⇒ [“2.3 Coolant Hose Connection Diagram”, page 119](#) .

13 - Bolt

- ☐ 25 Nm

14 - To Thermostat Housing

15 - Seal

- ☐ Replace





3 Diagnosis and Testing

⇒ **"3.1 Oil Pressure and Oil Pressure Switch, Checking",**
page 96

3.1 Oil Pressure and Oil Pressure Switch, Checking

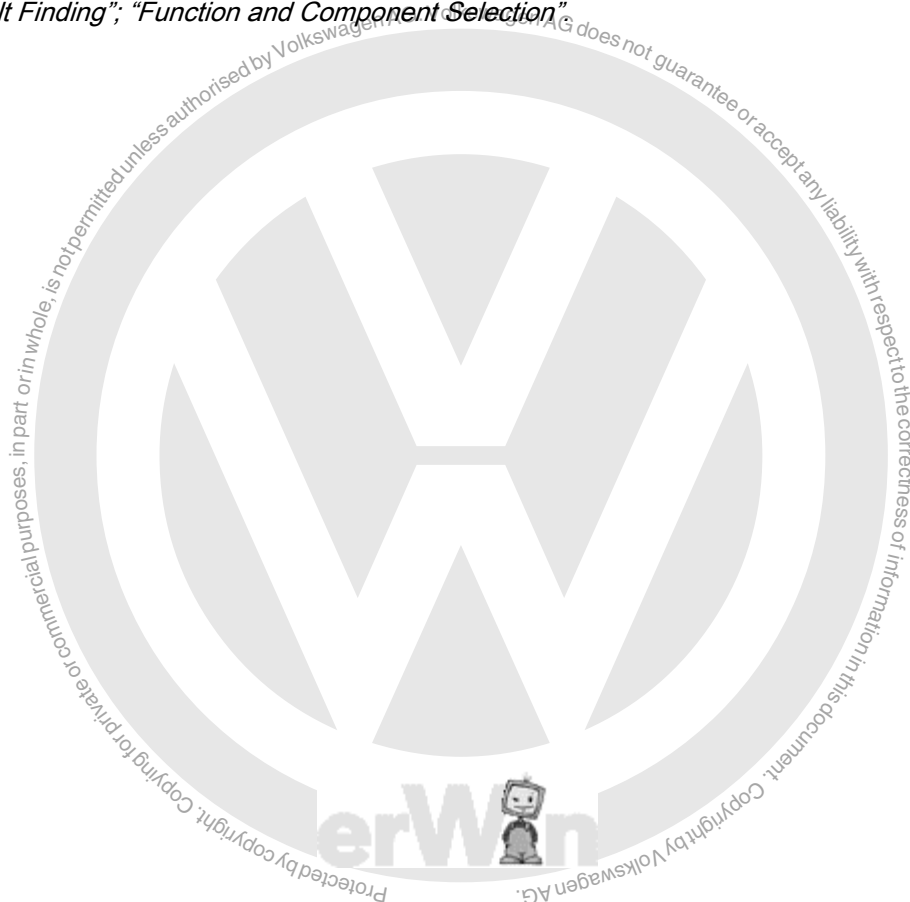
Special tools and workshop equipment required

- ◆ Oil Pressure Gauge Kit - VAG1342-
- ◆ Voltage Tester - VAG1527B-
- ◆ Connector Test Set - VAG1594A- or -VAG1594C-
- Engine oil level OK.
- Engine oil temperature at least 80 °C (176 °F) (coolant fan must start up once)



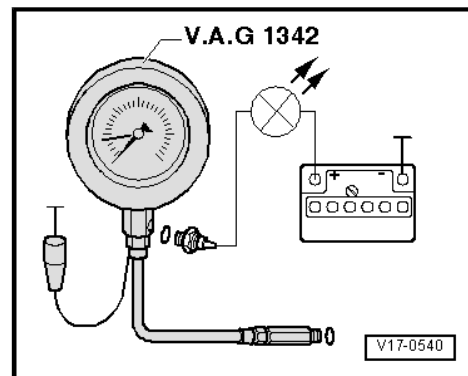
Note

For checking the function and servicing the optical and acoustic oil pressure display. Refer to ⇒ Wiring diagrams, Troubleshooting & Component locations and use the Vehicle Diagnostic Tester in "Guided Fault Finding"; "Function and Component Selection"





- Remove the Oil Pressure Switch - F1- and install the oil pressure gauge in its place.
- Thread oil pressure gauge into oil filter bracket in place of oil pressure switch.
- Connect the brown wire on the tester to the ground (-).
- Connect the Voltage Tester - VAS6839- to battery positive (+) and the oil pressure switch using adapter cables from the Connector Test Set - VAG1594D- .
- LED must not light up.
- If the LED lights up, replace the 1.4 bar Oil Pressure Switch - F1- .



If the LED does not light up:

- Start engine and increase engine speed.
- LED must light up at 1.2 to 1.6 bar positive pressure, otherwise replace oil pressure switch.
- Increase engine speed further.
- At higher engine speeds oil pressure must not exceed 7.0 bar
- At 2000 RPM and an oil temperature of 80 °C (176 °F), oil pressure must be 2.7...4.5 bar.

If the specification is not obtained:

- Check the oil intake pipe screen for dirt -item 22-
 ⇒ [Item 22 \(page 93\)](#) .



Note

Also, mechanical damage, for example, bearing damage can also be the cause of too low oil pressure.

If no malfunction can be found:

- Replace the oil pump:
- ◆ Engine codes BGP, BGQ and BTK. Refer to
 ⇒ ["4.4 Oil Pump", page 103](#) .
- ◆ Engine codes CBTA, CBUA and CCCA. Refer to
 ⇒ ["4.5 Oil Pump", page 106](#) .

If the specification is exceeded:

- Check the oil passages.
- Replace oil filter bracket if necessary.



4 Removal and Installation

⇒ ["4.1 Oil Filter Housing, Draining", page 98](#)

⇒ ["4.2 Oil Pan Lower Section", page 98](#)

⇒ ["4.3 Oil Pan Upper Section", page 100](#)

⇒ ["4.4 Oil Pump", page 103](#)

⇒ ["4.5 Oil Pump", page 106](#)

4.1 Oil Filter Housing, Draining

Special tools and workshop equipment required

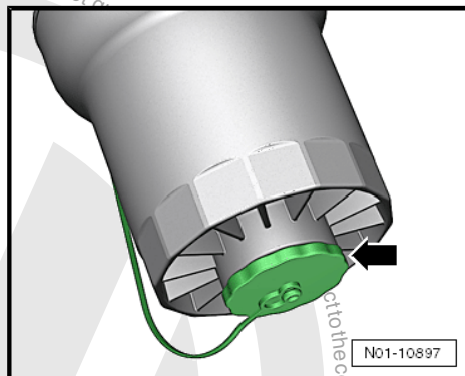
- ◆ Oil Drain Adapter - T40057-



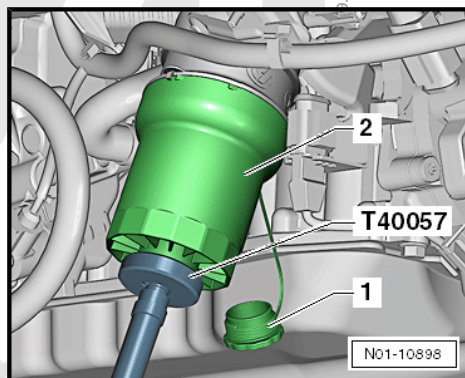
Note

When screwing in the Oil Drain Adapter - T40057-, a valve in the oil filter housing is opened. If the Oil Drain Adapter - T40057- is unscrewed, the valve closes again.

- Remove the dust cap -arrow- from the oil filter housing.



- Hold the hose from Oil Drain Adapter - T40057- in a container and screw the Oil Drain Adapter - T40057- into the oil filter housing -2- until it stops.
- Let engine oil drain.



4.2 Oil Pan Lower Section

Special tools and workshop equipment required

- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Hand Drill With Plastic Brush Attachment
- ◆ Protective eyewear
- ◆ Silicone Sealant - D 174 003 A2-

Removing

- Remove the noise insulation. Refer to ⇒ Body Exterior; Rep. Gr. 50 ; Noise Insulation .



- Drain the engine oil.



Note

Observe disposal regulations!

- Remove mounting bolts.
- Press off the oil pan lower section off at the tabs -arrows- on oil pan upper section. Be careful not to damage sealing surfaces in the process.
- Replace damaged lower section of oil pan.

Installing



WARNING

To prevent injuries from shavings, wear protective goggles and protective clothing.

- Remove the sealant residue from the upper and lower section of oil pan using for example a rotating plastic brush.



Caution

Make sure that no sealant residue enters the engine.

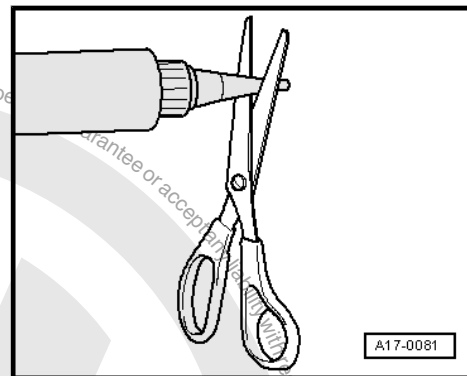
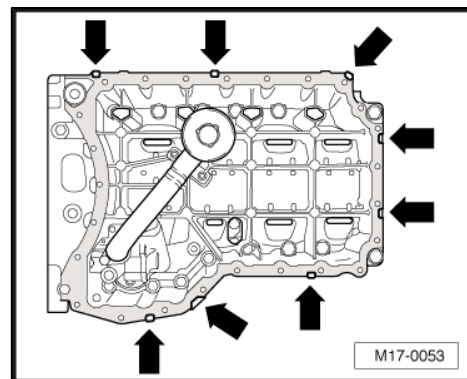
- Clean the sealing surfaces, they must be free of oil and grease.
- Cut the tube nozzle at the front marking (nozzle diameter: approximately 1 mm).

Note shelf-life date.



Note

The oil pan lower section must be installed within five minutes after applying the sealant.





- With engine removed, apply sealant bead -A- as depicted on to clean sealing surface of upper section of oil pan.
- ♦ Sealant bead must be 1.5 to 2.0 mm thick.



Note

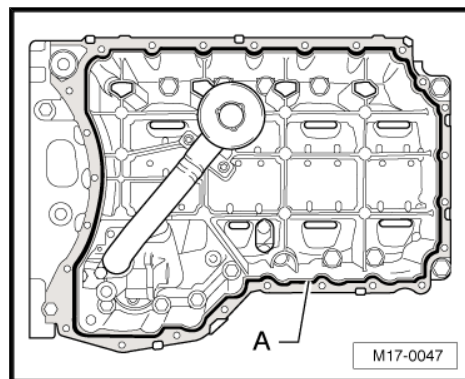
- ♦ *With the engine installed, apply the sealant to the oil pan lower section the same way.*
- ♦ *Sealant bead must be routed on inside on holes for bolts.*
- Install all the bolts and tighten them diagonally.

The rest of the installation follows the reverse of the removal procedures. Note the following:

- ♦ After installing lower section of oil pan, allow sealant to dry for approximately 30 minutes. Only after then may the engine oil be replenished.

Tightening Specification:

Component	Nm
Oil pan lower section to oil pan upper section	10



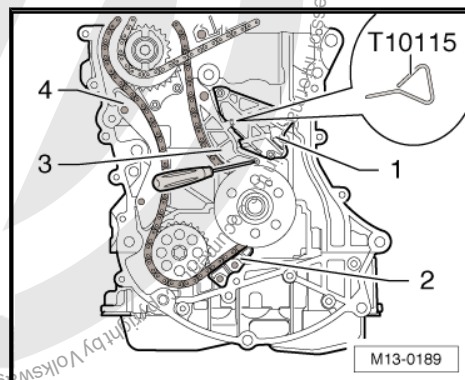
4.3 Oil Pan Upper Section

Special tools and workshop equipment required

- ♦ Torque Wrench 1331 5-50Nm - VAG1331-
- ♦ Locking Pin - T10115-
- ♦ Seal Installer - Valve Stem Seal Tool Adapter Plates - 2036/1- (not illustrated)
- ♦ M8x20 bolts quantity: 3, washers quantity: 3
- ♦ Hand Drill With Plastic Brush Attachment
- ♦ Protective eyewear
- ♦ Silicone Sealant - D 174 003 A2-

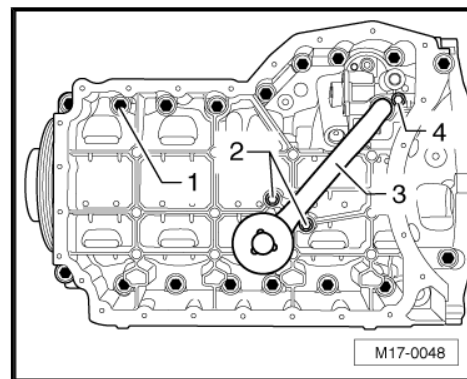
Removing

- Loosen camshaft gears (refer to [⇒ "3.2 Valve Timing, Adjusting", page 64](#)), adjusting valve timing.
- Remove control housing cover. Refer to [⇒ "4.4 Control Housing Cover", page 49](#) .
- Tension the chain tensioner -1- and secure it using the Locking Pin - T10115- .
- Remove the rail -2-
- Remove the crankshaft sealing flange -belt pulley side-. Refer to [⇒ "4.3 Crankshaft Sealing Flange, Belt Pulley Side", page 46](#) .
- Remove the oil pan lower section. Refer to [⇒ "4.2 Oil Pan Lower Section", page 98](#) .





- Remove the bolts -2- and -4- and the oil intake pipe.
- Remove the bolts -1-.



- Press the oil pan upper section from cylinder block at designated points using a suitable screwdriver -A-.

B - Crankshaft Bearing Cap 6

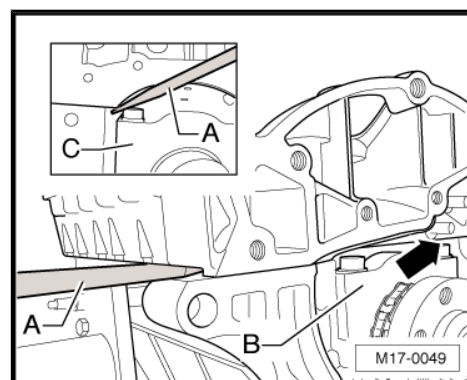
C - Crankshaft Bearing Cap 1

Installing



WARNING

To prevent injuries from shavings, wear protective goggles and protective clothing.



- Remove sealant residue from the oil pan upper section using for example a rotating plastic brush.



Caution

Make sure that no sealant residue enters the engine.

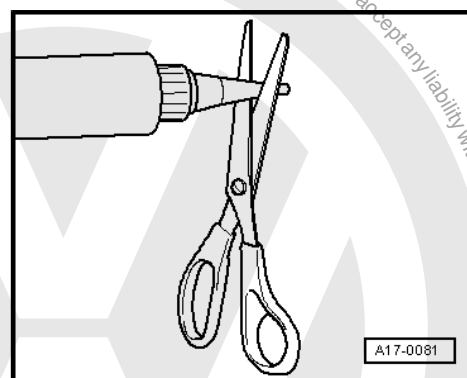
- Clean the sealing surfaces, they must be free of oil and grease.
- Cut the tube nozzle at the front marking (nozzle diameter: approximately 1 mm).

Note shelf-life date.



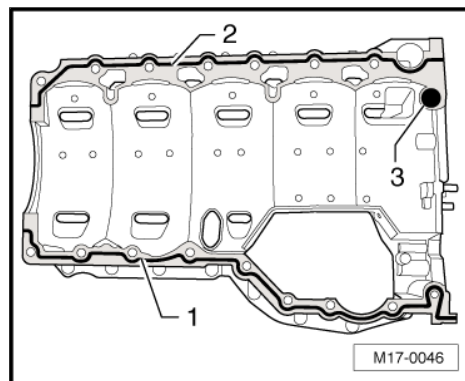
Note

The oil pan upper section must be installed within five minutes after applying the sealant.

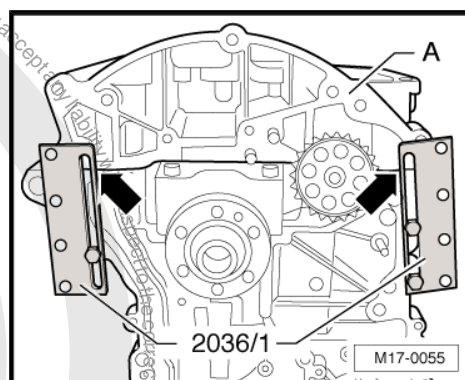




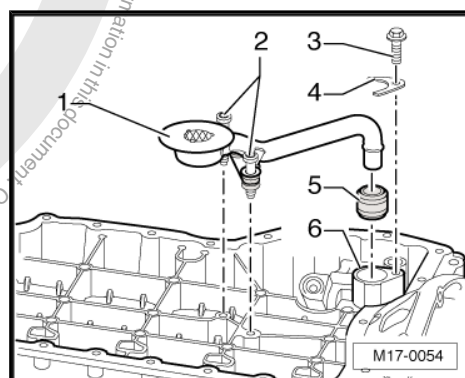
- Apply sealant beads -1-, -2- and -3- to the clean sealing surfaces on the oil pan upper section as illustrated.
- Sealant bead must be 1.5 to 2.0 mm thick.
- Position the oil pan upper section on the cylinder block and align it on the transmission side.
- Screw in two bolts each at front and rear hand-tight.



- Wipe off any excess sealant -arrows-.
- Loosen bolts again slightly.
- Secure plates the Seal Installer - Valve Stem Seal Tool Adapter Plates -2036/1- from the Seal Installer - Valve Stem Seal Tool -2036- on cylinder block as shown.
- Press the oil pan upper section firmly on to the Seal Installer - Valve Stem Seal Tool Adapter Plates -2036/1- and tighten bolts again hand-tight.
- Screw in remaining bolts and tighten by hand.



- Make sure that the upper part of oil pan is in contact with the Seal Installer - Valve Stem Seal Tool Adapter Plates -2036/1- .
- Tighten all bolts in diagonal sequence from inside working toward outside.
 - Install the new seal -5- in the oil pump -6-.
 - Install the oil intake pipe -1- using the bolts -2- and -3- as well as the bracket -4-.





- Install the glide rail -2-, relieve tension on chain tensioner -1- and pull out the Locking Pin - T10115- .
- Adjust the valve timing. Refer to
 ⇒ [“3.2 Valve Timing, Adjusting”, page 64](#) .

The rest of the installation follows the reverse of the removal procedures. Note the following:

- ◆ After installing the oil pan, allow the sealant to dry for approximately 30 minutes. Only after then may the engine oil be replenished.
- ◆ Remove the Crankshaft Locking Pin - T40069- from the back of the cylinder block and install the bolt.
- ◆ Fill the coolant. Refer to
 ⇒ [“4.1 Coolant, Draining and Filling”, page 123](#) .

Tightening specifications:

Component	Nm
Oil pan upper section to cylinder block	25
Oil intake pipe to oil pump	10
Oil intake pipe to oil pan upper section	10

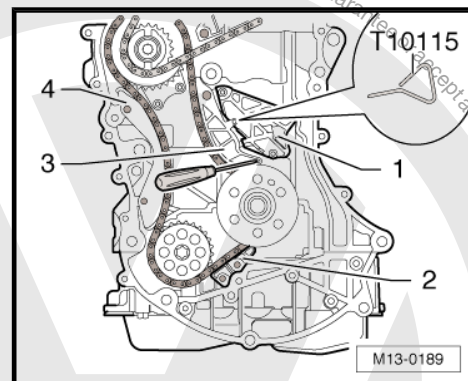
4.4 Oil Pump

Special tools and workshop equipment required

- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Counterhold - Kit - Multiple Use - T10172-
- ◆ Oil Pump Alignment Plate - T03005-

Removing

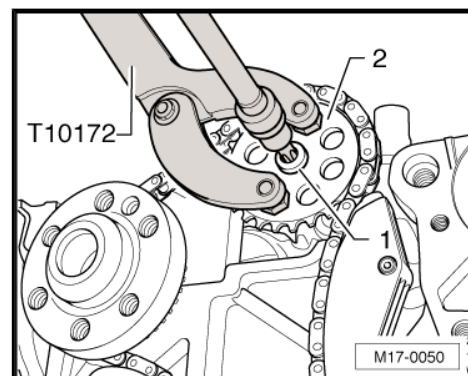
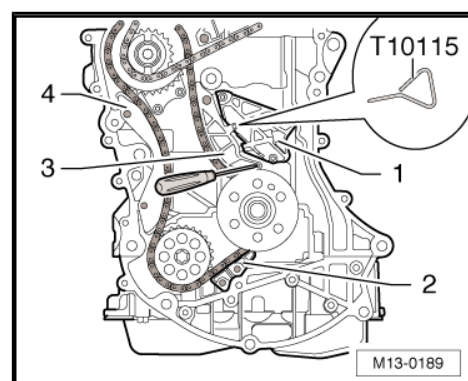
- Remove the oil pan upper section. Refer to
 ⇒ [“4.3 Oil Pan Upper Section”, page 100](#) .
- Tension the chain tensioner -1-, lock it using the Locking Pin - T10115- and remove it.



- Remove the bolt -1-.
- Hold the chain sprocket -2- using the Counterhold - Kit - Multiple Use - T10172- .
- Remove the chain sprocket from the oil pump and then remove the oil pump.

Installing

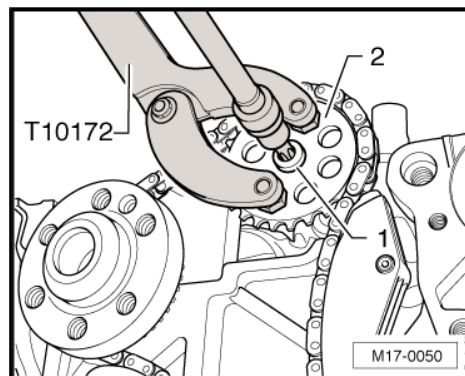
- Crankshaft is secured



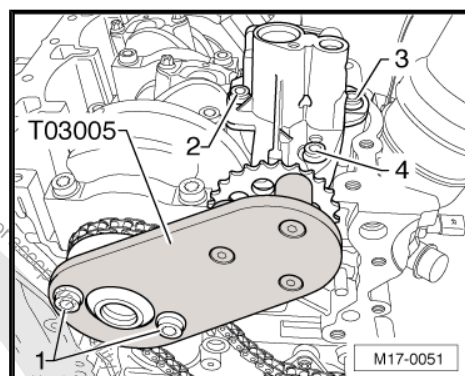


- Replace the O-ring -item 25- ➔ **Item 25 (page 93)** and hand-tighten the screws with the oil pump to the cylinder block.
- Place chain sprocket with lettering facing outward on to oil pump shaft and firmly bolt it with a new bolt -1- (drive chain not yet installed).

Tightening specification: 20 Nm + 90° (1/4 turn) additional turn



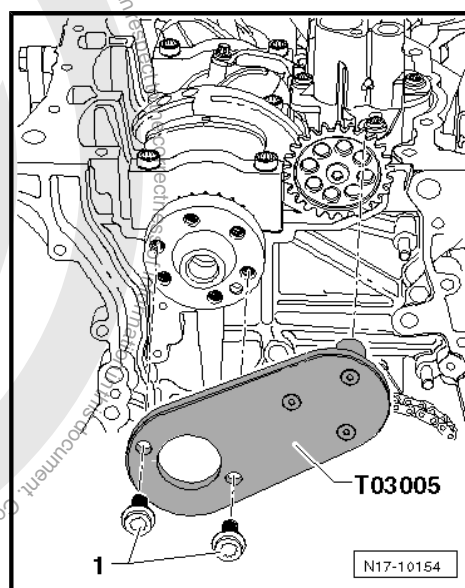
- Loosen the bolts -2 through 4-.
- Oil pump must be able to be slid easily.
- Check the Oil Pump Alignment Plate - T10172- . If there are still protective shields on the magnets, remove them.
- Check that there are no shavings located on magnets from the Oil Pump Alignment Plate - T03005- .
- The contact surfaces on the crankshaft, the tool and the chain sprocket must be clean.



- Place the Oil Pump Alignment Plate - T03005- on the crankshaft journal and bolt it with two bolts -1- from the vibration damper/belt pulley.

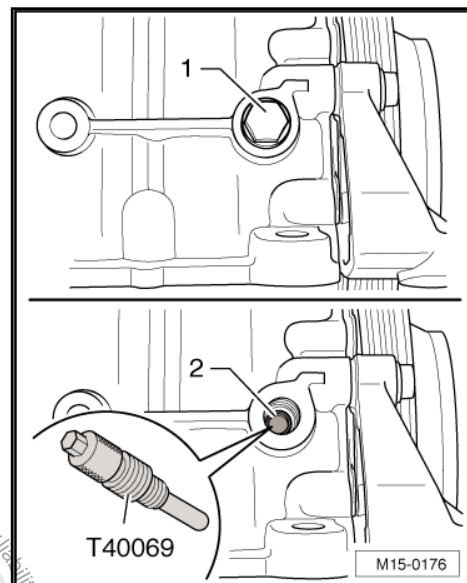
Tightening specification: 30 Nm.

Oil pump is activated by magnets.





- Remove the Crankshaft Locking Pin - T40069- .



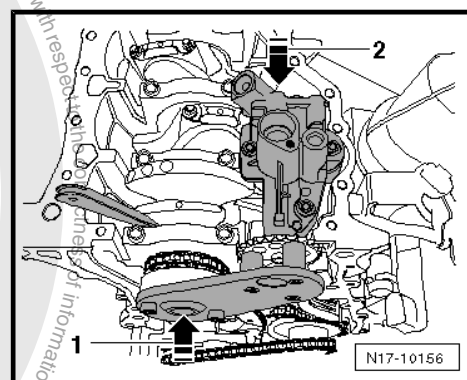
- Press the crankshaft in the axial bearing play toward the belt drive -arrow 1- and secure it with a -shim- as shown in the illustration.

Press the oil pump lightly toward the chain drive -arrow 2-.

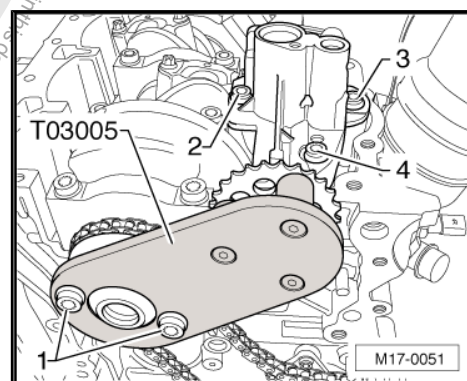


Note

This work step is important in order to guarantee correct position of chain sprockets to each other.



- Tighten the bolts -2- and -3- first and then the bolt -4- to 25 Nm.
- Install the Crankshaft Locking Pin - T40069- again. Crankshaft must only be rotated slightly around TDC point for this. Otherwise there is a risk the valves rest on the pistons.
- Remove the Oil Pump Alignment Plate - T03005-.
- If a new oil pump is installed, fill oil pump with some engine oil via intake channel and rotate oil pump several times through.
- Place drive chain on to oil pump chain sprocket.
- Install the oil pan upper section. Refer to ["4.3 Oil Pan Upper Section", page 100](#) .





- Install the glide rail -2-, relieve tension on chain tensioner -1- and pull out the Locking Pin - T10115- .



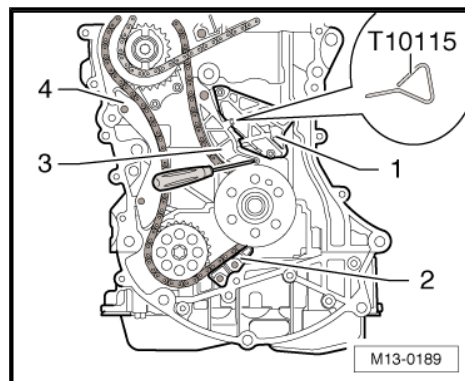
Note

Make sure that drive chain lies correct in glide track -4- and in tensioning track -3-.

- Adjust the valve timing. Refer to
⇒ [“3.2 Valve Timing, Adjusting”, page 64](#) .

The rest of the installation follows the reverse of the removal procedures. Note the following:

- ♦ Remove the Crankshaft Locking Pin - T40069- from the cylinder block at the rear and install the plug (30 Nm).
- ♦ Fill the coolant. Refer to
⇒ [“4.1 Coolant, Draining and Filling”, page 123](#) .



4.5 Oil Pump

Special tools and workshop equipment required

- ♦ Torque Wrench 1331 5-50Nm - VAG1331-
- ♦ Counterhold - Kit - Multiple Use - T10172-
- ♦ Oil Pump Alignment Plate - T03005-
- ♦ Oil Pump Shim - T03005/1-

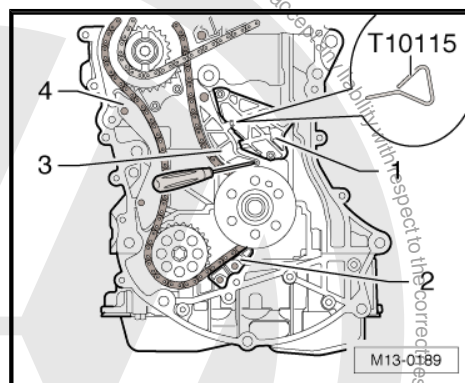


Note

In MY 2008, the timing mechanism drive chain was changed from a roller chain to a toothed chain. The gears are now wider and tool T03005/1 must also be used when securing the oil pump.

Removing

- Remove the oil pan upper section. Refer to
⇒ [“4.3 Oil Pan Upper Section”, page 100](#) .
- Tension the chain tensioner -1-, lock it using the Locking Pin - T10115- and remove it.





- Remove the bolt -1-.

Hold the chain sprocket -2- using the Counterhold - Kit - Multiple Use - T10172- .

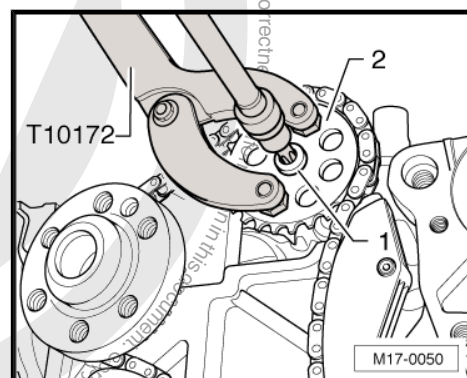
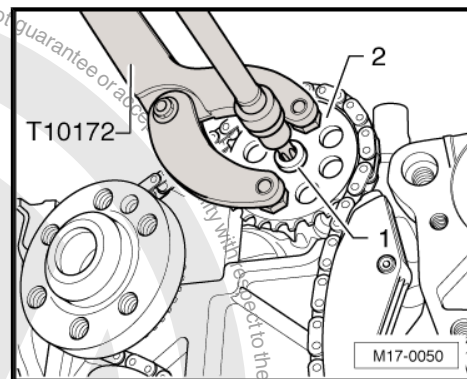
- Remove the chain sprocket from the oil pump and then remove the oil pump.

Installing

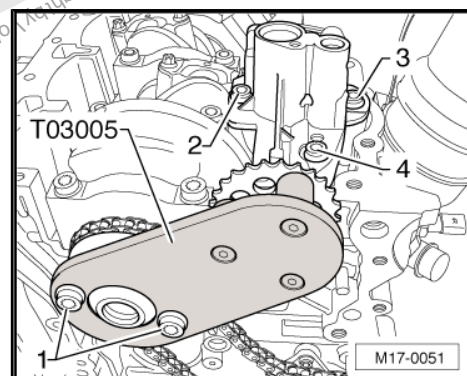
- Crankshaft is secured
- Replace the O-ring -item 25- ⇒ [Item 25 \(page 93\)](#) .

- Attach the oil pump to cylinder block hand-tight.
- Place chain sprocket with lettering facing outward on to oil pump shaft and firmly bolt it with a new bolt -1- (drive chain not yet installed).

Tightening specification: 20 Nm + 90° (1/4 turn) additional turn



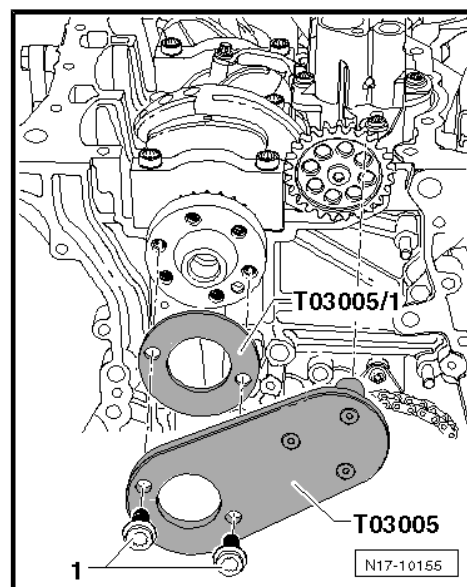
- Loosen the bolts -2 through 4-.
- Oil pump must be able to be slid easily.
- Check the Oil Pump Alignment Plate - T10172- . If there are still protective shields on the magnets, remove them.
- Check that there are no shavings located on magnets from the Oil Pump Alignment Plate - T03005- .
- The contact surfaces on the crankshaft, the tools and the chain sprocket must be clean.



- Place the Oil Pump Shim - T03005/1- and the Oil Pump Alignment Plate - T03005- on the crankshaft pins and secure both with the two bolts -1- from the vibration damper/belt pulley.

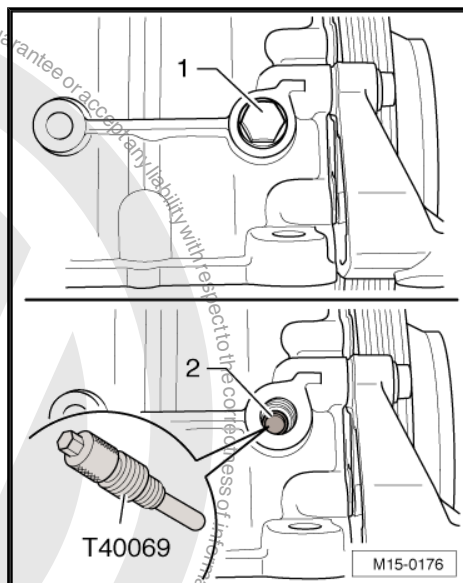
Tightening specification: 30 Nm.

Oil pump is activated by magnets.





- Remove the Crankshaft Locking Pin - T40069- .

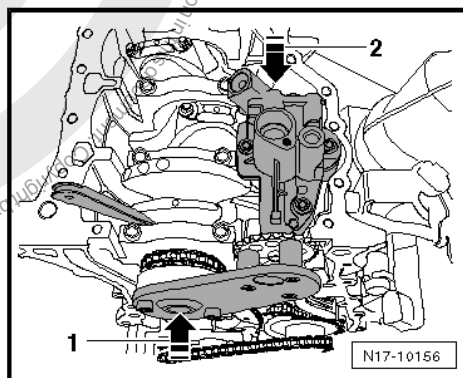


- Press the crankshaft in the axial bearing play toward the belt drive -arrow 1- and secure it with a -shim- as shown in the illustration.
- Press the oil pump lightly toward the chain drive -arrow 2-.

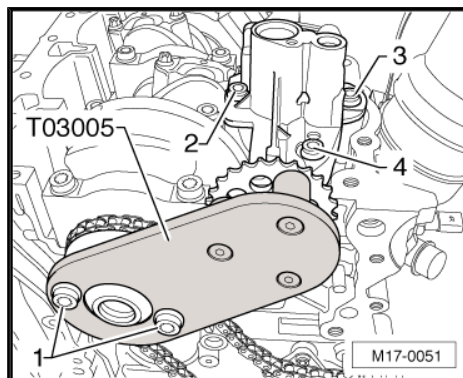


Note

This work step is important in order to guarantee correct position of chain sprockets to each other.



- Tighten the bolts -2- and -3- first and then the bolt -4- to 25 Nm.
- Install the Crankshaft Locking Pin - T40069- again. Crankshaft must only be rotated slightly around TDC point for this. Otherwise there is a risk the valves rest on the pistons.
- Remove the Oil Pump Alignment Plate - T03005- and the Oil Pump Shim - T03005/1- .
- If a new oil pump is installed, fill oil pump with some engine oil via intake channel and rotate oil pump several times through.
- Place drive chain on to oil pump chain sprocket.
- Install the oil pan upper section. Refer to [⇒ "4.3 Oil Pan Upper Section", page 100](#) .





- Install the glide rail -2-, relieve tension on chain tensioner -1- and pull out the Locking Pin - T10115- .



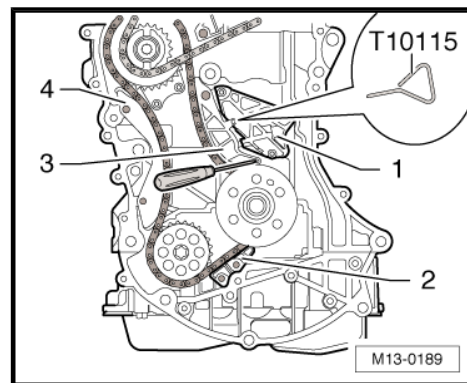
Note

Make sure that drive chain lies correct in glide track -4- and in tensioning track -3-.

- Adjust the valve timing. Refer to
⇒ [“3.2 Valve Timing, Adjusting”, page 64](#) .

The rest of the installation follows the reverse of the removal procedures. Note the following:

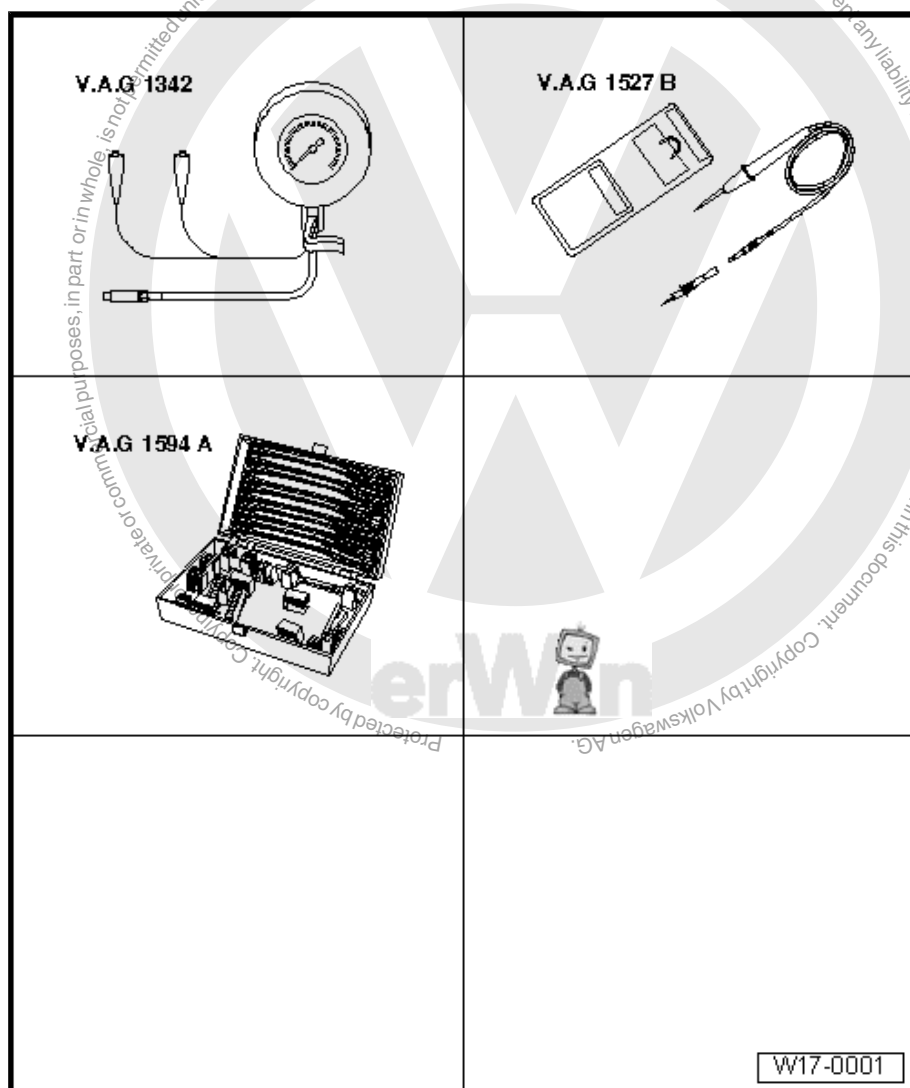
- ◆ Remove the Crankshaft Locking Pin - T40069- from the cylinder block at the rear and install the plug (30 Nm).
- ◆ Fill the coolant. Refer to
⇒ [“4.1 Coolant, Draining and Filling”, page 123](#) .



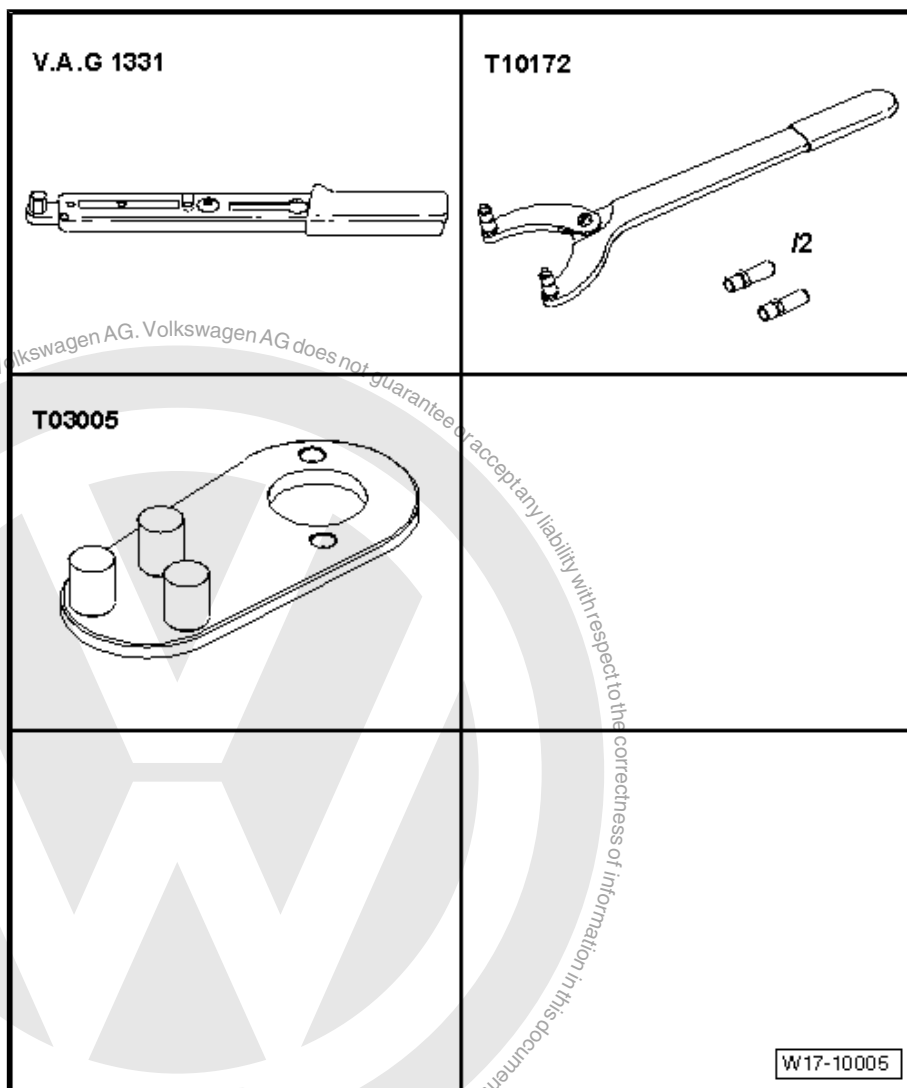


5 Special Tools

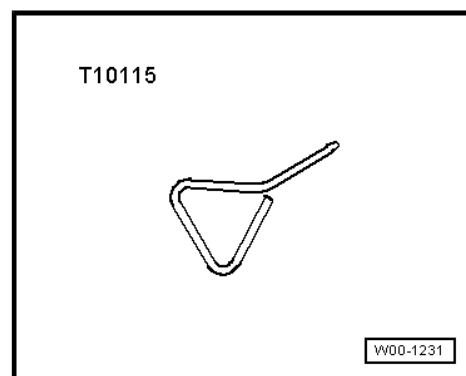
Special tools and workshop equipment required



- ◆ Oil Pressure Gauge Kit - VAG1342-
- ◆ Voltage Tester - VAG1527B-
- ◆ Connector Test Set - VAG1594A- or -VAG1594C-

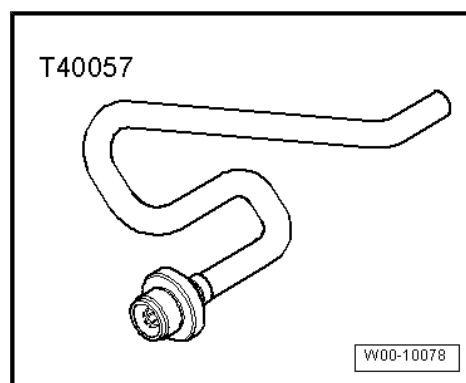


- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Counterhold - Kit - Multiple Use - T10172-
- ◆ Oil Pump Alignment Plate - T03005-
- ◆ Locking Pin - T10115-





◆ Oil Drain Adapter - T40057-



◆ Torque Wrench 1331 5-50Nm - VAG1331-





19 – Cooling System

1 General Information

⇒ [“1.1 Cooling System Components”, page 113](#)

1.1 Cooling System Components



WARNING

Hot steam may escape when opening the reservoir.

- ◆ *Wear protective eyewear and protective clothing to prevent eye injury and scalding.*
- ◆ *Cover the cap with a cloth and open very carefully.*



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.*



Note

- ◆ *When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing repair work.*
- ◆ *Secure all hose connections with hose clamps, allocation. Refer to the Parts Catalog.*
- ◆ *Use Spring-Type Clip Pliers to installing spring clips.*
- ◆ *Replace the gaskets and seals.*
- ◆ *Arrows on coolant pipes and coolant hoses must line up across from each other.*



2 Description and Operation

⇒ ["2.1 Overview - Engine-Side Coolant System Components", page 114](#)

⇒ ["2.2 Overview - Body-Side Coolant System Components", page 118](#)

⇒ ["2.3 Coolant Hose Connection Diagram", page 119](#)

2.1 Overview - Engine-Side Coolant System Components

Part 1

Part 2. Refer to ⇒ [page 115](#)

1 - Cylinder Block

2 - Oil Cooler

3 - Bolt

□ 25 Nm

4 - Bolt

□ 10 Nm

5 - To heater core of heater, bottom

6 - Clip

7 - O-Ring

□ Replace

8 - Front Coolant Pipe

9 - Connecting Hose

10 - O-Ring

□ Replace

11 - Coolant Pipe

12 - Connecting Hose

13 - Connection

14 - To Radiator, Bottom

15 - Bolt

□ 5 Nm

16 - O-Ring

□ Replace

17 - Coolant Thermostat

□ Removing and installing. Refer to

⇒ ["4.3 Coolant Thermostat", page 129](#)

□ Note installation position:

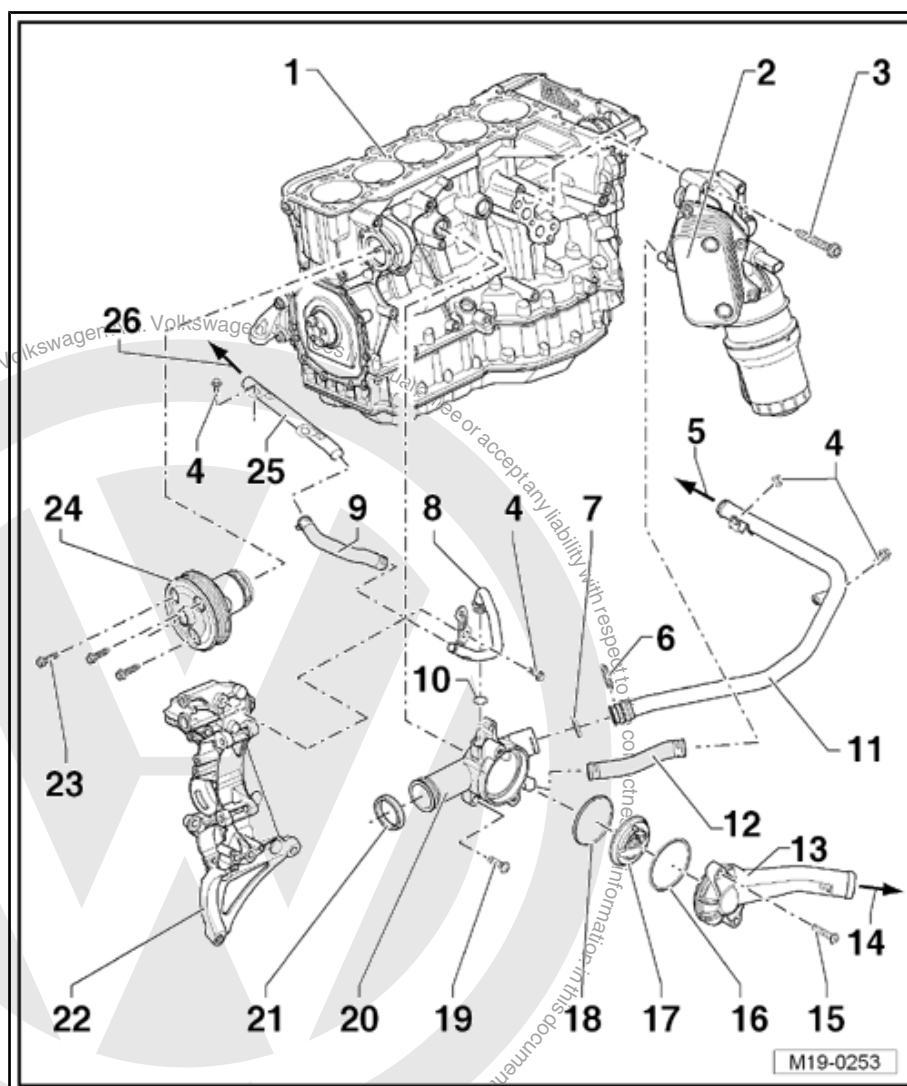
Valve must be at top

□ Checking (coolant thermostat installed):

Refer to the Vehicle Diagnostic Tester in "Guided Functions"

□ checking (coolant thermostat removed):

Heat up thermostat in water





Starts to open: approximately 80 °C (176 °F)
Opening end: approximately 95 °C (203 °F)
Opening lift: minimum 8 mm

18 - Seal

- ☐ Replace

19 - Bolt

- ☐ 9 Nm

20 - Coolant Thermostat Housing

21 - Seal

- ☐ Replace

22 - Sub-Assembly Bracket

23 - Bolt

- ☐ 10 Nm

24 - Coolant Pump

- ☐ With integrated silicone sealing ring for the cylinder block seal
- ☐ Removing and installing. Refer to ➤ [“4.2 Coolant Pump”, page 126](#) .

25 - Right Coolant Pipe

- ☐ Secured to the engine mount

26 - To Expansion Tank, Bottom

Part 2

Part 1. Refer to ➤ [page 114](#)



1 - Coolant Connection

- ☐ Pressed in cylinder head
- ☐ Clean before installing the coolant distribution housing -item 17- ➔ [Item 17 \(page 116\)](#) .
- If necessary, remove coolant deposits using a copper wire brush or fine sandpaper (minimum 100 grit).
- ☐ If the pipe connection is worn, replace it using Locking Fluid - D 000600 A2- .

2 - Circlip

3 - Seal

- ☐ Replace after removing coolant distribution housing -item 17- ➔ [Item 17 \(page 116\)](#) .

4 - To Expansion Tank, Top

5 - Rear Coolant Pipe

6 - Bolt

- ☐ 10 Nm

7 - Heat Shield

8 - To Heater Core, Top

9 - Supply Hose

10 - Bypass Thermostat

- ☐ Only for vehicles with an automatic transmission
- ☐ Overview. Refer to ➔ [Fig. "Overview - Bypass Thermostat" , page 117](#) .
- ☐ Checking. Refer to ➔ [page 117](#) .

11 - To ATF Cooler

- ☐ Only for vehicles with an automatic transmission

12 - To Heater Core, Bottom

13 - From ATF Cooler

- ☐ Only for vehicles with an automatic transmission

14 - Return Hose

15 - Coolant Pipe

- ☐ Bolted to coolant regulator housing -item 17- ➔ [Item 17 \(page 116\)](#) .

16 - To Coolant Regulator Housing

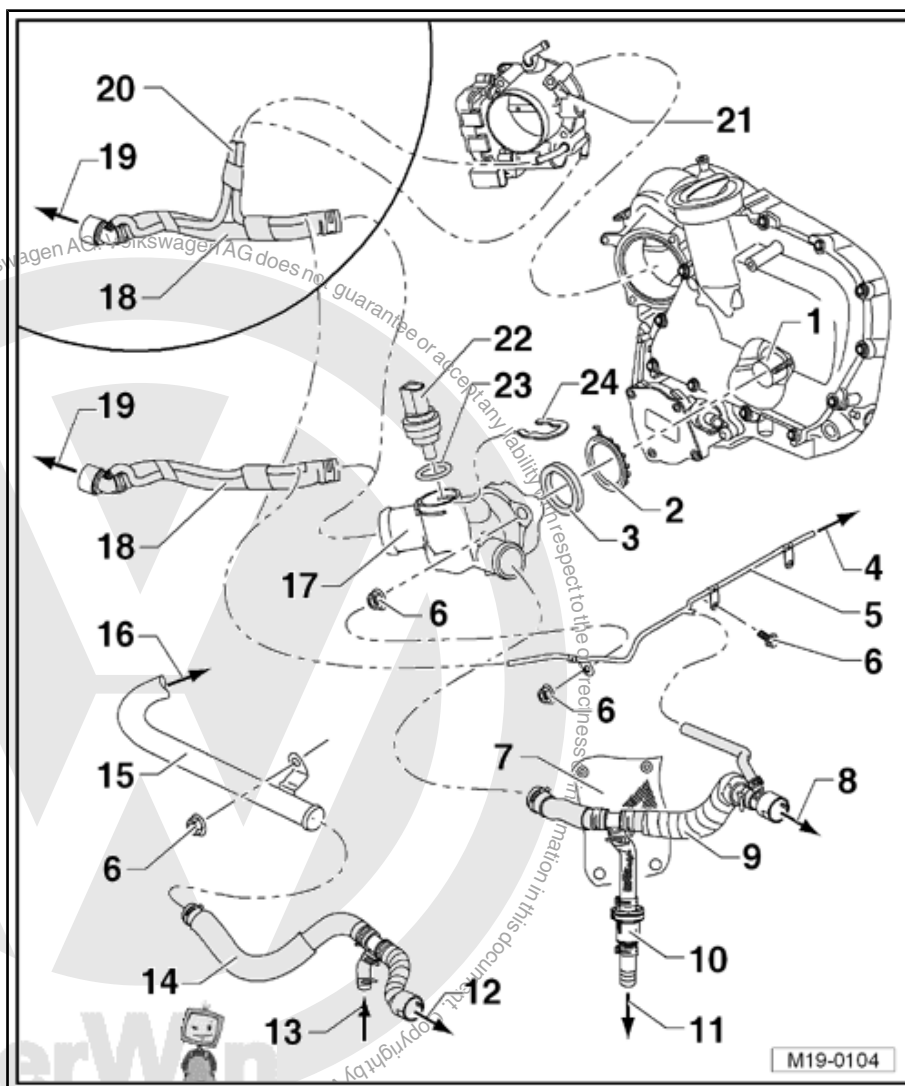
17 - Coolant Distribution Housing

18 - Supply Hose

19 - To Top of Radiator

20 - Coolant Hoses

- ☐ Only for the coolant reservoir Throttle Valve Control Module - J338-





21 - Throttle Valve Control Module - J338-

22 - Engine Coolant Temperature Sensor - G62-

23 - O-Ring

- Replace

24 - Clip

Overview - Bypass Thermostat

1 - Spring Bracket

2 - Housing Lower Section

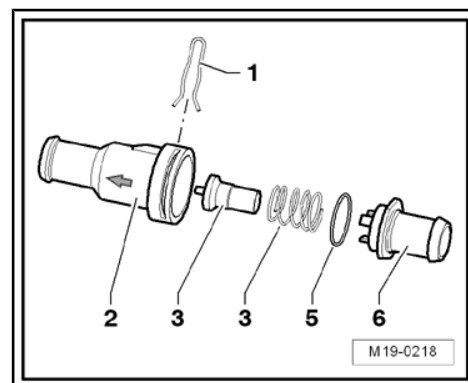
- Pay attention to the installed position: the arrow points to the ATF cooler

3 - Operating Element

4 - Spring

5 - O-Ring

6 - Housing Upper Section



Checking bypass thermostat

- Remove the operating element -3- and warm it up in hot water.
Opening begins: approximately 75 °C
Opening ends: approximately 85 °C
Opening travel: approximately 5 mm



2.2 Overview - Body-Side Coolant System Components

1 - Upper Coolant Hose

- From the coolant distribution housing to cylinder head

2 - O-Ring

- ☐ Replace if damaged

3 - Radiator

- ❑ Removing and installing. Refer to ⇒ "4.5 Radiator", page 131.
- ❑ After replacing, replace entire amount of coolant.

4 - Seal

5 - Cap

- ❑ Check using Cooling System Tester - VAG1274B- and Cooling System Tester - Adapter - VAG1274/9- . Refer to
⇒ “3.1 Cooling System, Checking for Leaks”, page 121 .
- ❑ The pressure relief valve must open at 1.4 to 1.6 bar

6 - Connector

7 - Bolt

- 2 Nm

8 - Reservoir

- ❑ Perform a leak test for the coolant system using the Cooling System Tester - VAG1274B- and Cooling System Tester - Adapter - VAG1274/8- . Refer to ⇒ **“3.1 Cooling System, Checking for Leaks”, page 121** .

9 - Mount

- For the radiator

10 - Bolt

- 7 Nm

11 - Spacer

- ❑ For refrigerant line bracket

12 - Mount

- Insert in lock carrier

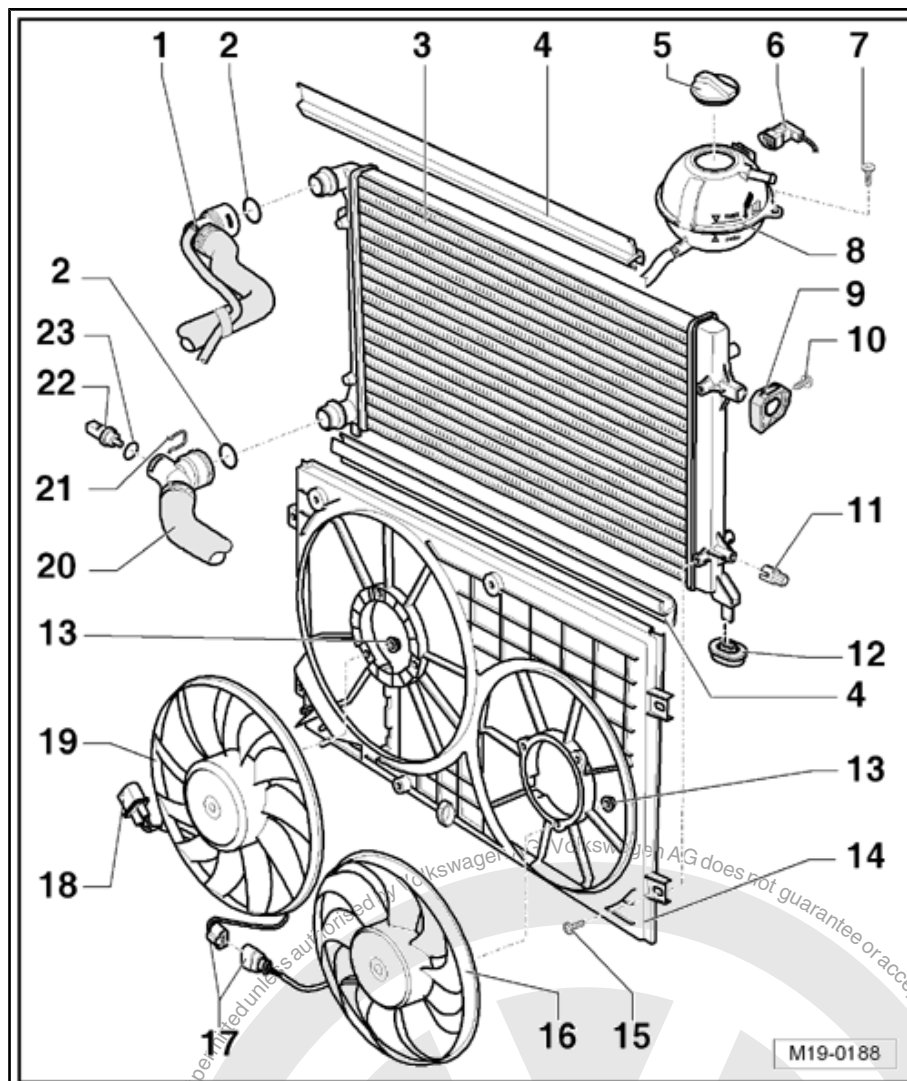
13 - Bolt

- 5 Nm

14 - Air Shroud

15 - Bolt

- 5 Nm





16 - Coolant Fan 2 - V177-

- ☐ Removing and installing. Refer to ➤ [“4.4 Coolant Fan V7 and Coolant Fan 2 V177”, page 131](#) .

17 - Connector

18 - Connector

19 - Coolant Fan - V7-

- ☐ Removing and installing. Refer to ➤ [“4.4 Coolant Fan V7 and Coolant Fan 2 V177”, page 131](#) .
- ☐ With Coolant Fan Control Module - J293-

20 - Lower Coolant Hose

- ☐ From connection for coolant regulator

21 - Clip

22 - Engine Coolant Temperature Sensor on Radiator Outlet - G83-

23 - O-Ring

- ☐ Replace

2.3 Coolant Hose Connection Diagram

1 - Radiator

- ☐ Removing and installing. Refer to ➤ [“4.5 Radiator”, page 131](#) .
- ☐ Replace the coolant after replacing the heater core.

2 - Coolant Pipe

3 - Intake Manifold

4 - Coolant Pump and Coolant Thermostat

- ☐ Coolant Pump, Removing and Installing. Refer to ➤ [“4.2 Coolant Pump”, page 126](#) .
- ☐ Coolant thermostat, removing and installing. Refer to ➤ [“4.3 Coolant Thermostat”, page 129](#) .
- ☐ Checking coolant regulator. Refer to -item 17- ➤ [Item 17 \(page 114\)](#) .

5 - Front Coolant Pipe

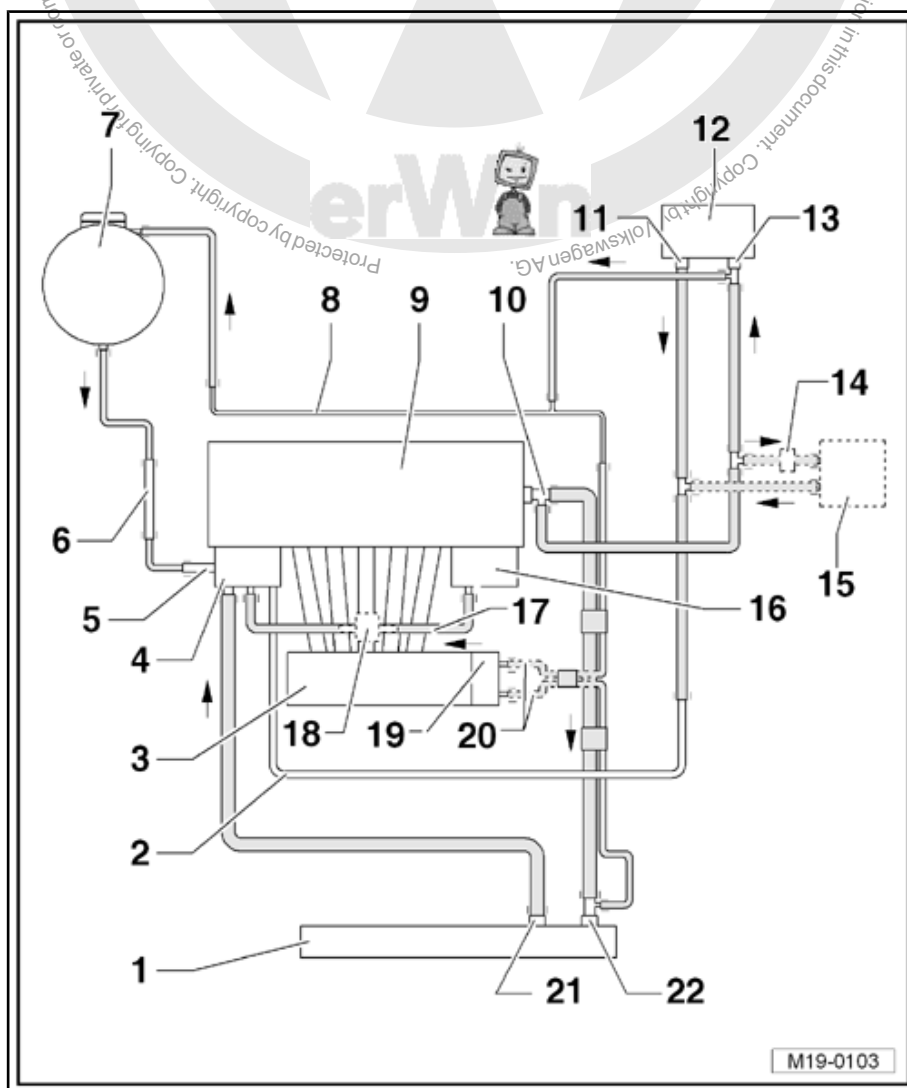
- ☐ Secured to bracket for assemblies

6 - Right Coolant Pipe

- ☐ Secured to the engine mount

7 - Reservoir

- ☐ With cap
- ☐ Pressure relief valve inside cap, checking. Refer to ➤ [“3.1 Cooling System, Checking for Leaks”, page 121](#) .





8 - Rear Coolant Pipe

9 - Cylinder Head/Cylinder Block

- ☐ Replace the coolant after replacing the heater core.

10 - Coolant Distribution Housing

11 - Quick-Release Coupling

- ☐ Lower connection

12 - Heater Core

- ☐ Replace the coolant after replacing the heater core.

13 - Quick-Release Coupling

- ☐ Upper connection

14 - Bypass Thermostat

- ☐ Only for vehicles with an automatic transmission
- ☐ Overview. Refer to ➤ [Fig. ""Overview - Bypass Thermostat"" , page 117 .](#)
- ☐ Checking. Refer to ➤ [page 117 .](#)

15 - ATF Cooler

- ☐ Only for vehicles with an automatic transmission

16 - Oil Cooler

17 - Coolant Hose

There are two versions:

- ☐ Without an engine preheater
- ☐ With an engine preheater

18 - Preheater

- ☐ Only on vehicles with an engine preheater

19 - Throttle Valve Control Module - J338-

- ☐ Connection only for coolant heated throttle valve control module

20 - Coolant Hoses

- ☐ Only for the coolant reservoir Throttle Valve Control Module - J338-

21 - Quick-Release Coupling

- ☐ Lower connection

22 - Quick-Release Coupling

- ☐ Upper connection



3 Diagnosis and Testing

⇒ **"3.1 Cooling System, Checking for Leaks", page 121**

3.1 Cooling System, Checking for Leaks

Special tools and workshop equipment required

- ◆ Cooling System Tester - VAG1274B-
- ◆ Cooling System Tester - Adapter - VAG1274/8-
- ◆ Cooling System Tester - Adapter - VAG1274/9-

Test Conditions

- Engine at operating temperature.

Test Sequence



WARNING

Hot steam may escape when opening the reservoir.

- ◆ *Wear protective eyewear and protective clothing to prevent eye injury and scalding.*
- ◆ *Cover the cap with a cloth and open very carefully.*

- Open cap of coolant expansion tank.
- Install the Cooling System Tester - Adapter - VAG1274/8- in the coolant expansion tank.
- Clamp the Adapter - VAG1274B/1- in the Cooling System Tester - Adapter - VAG1274/8- .
- Connect the Adapter - VAG1274B/1- to the Cooling System Tester - VAG1274B- using the hose provided.

Generate a positive pressure of approximately 1.0 bar using hand pump of tester.



WARNING

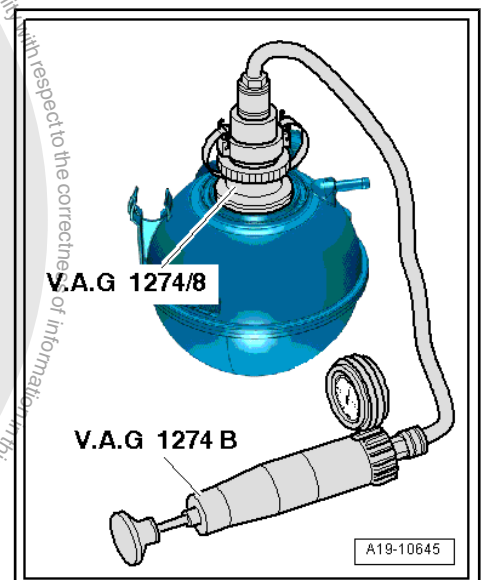
Risk of scalding! The existing pressure must be reduced before disconnecting the Cooling System Tester - VAG1274B- from the connecting hose or the Adapter - VAG1274B/1- . To do this, press the pressure release valve on the Cooling System Tester - VAG1274B- until the pressure gauge displays the value »0«.

If the pressure drops:

- Search for leaking areas and repair the malfunction.

Pressure Relief Valve in Cap, Checking

- Install the cap in the Cooling System Tester - Adapter - VAG1274/9- .
- Clamp the Adapter - VAG1274B/1- in the Cooling System Tester - Adapter - VAG1274/9- .

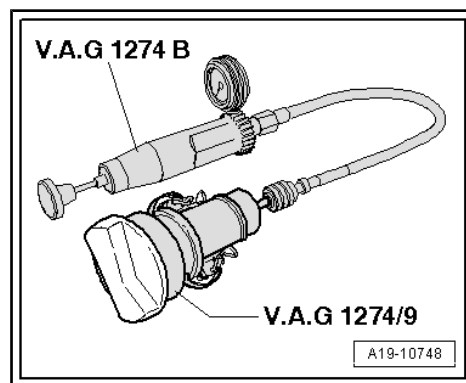




- Connect the Adapter - VAG1274B/1- to the Cooling System Tester - VAG1274B- using the hose provided.
- Actuate the hand pump.
- The pressure release valve must open at 1.4 to 1.6 bar.

If the pressure relief valve opens too early or too late:

- Replace cap.





4 Removal and Installation

⇒ [“4.1 Coolant, Draining and Filling”, page 123](#)

⇒ [“4.2 Coolant Pump”, page 126](#)

⇒ [“4.3 Coolant Thermostat”, page 129](#)

⇒ [“4.4 Coolant Fan V7 and Coolant Fan 2 V177 ”, page 131](#)

⇒ [“4.5 Radiator”, page 131](#)

4.1 Coolant, Draining and Filling

Special tools and workshop equipment required

- ◆ Refractometer - T10007A-
- ◆ Drip Tray - VAG1306- or Shop Crane - Drip Tray - VAS6208-
- ◆ Hose Clip Pliers
- ◆ Cooling System Charge Kit - VAS6096-
- ◆ Cooling System Tester - Adapter - VAG1274/8-

Draining



Note

- ◆ *Drained coolant must be stored in a clean container for disposal or reuse.*
- ◆ *Follow disposal regulations.*



WARNING

Hot steam may escape when opening the reservoir.

- ◆ *Wear protective eyewear and protective clothing to prevent eye injury and scalding.*
- ◆ *Cover the cap with a cloth and open very carefully.*

- Remove the cap from the coolant reservoir.
- Remove the noise insulation. Refer to ⇒ Body Exterior; Rep. Gr. 50 ; Noise Insulation .
- Place the Drip Tray - VAG1306- or Shop Crane - Drip Tray - VAS6208- underneath.



- Open the spring clamp -arrow- and disconnect the coolant hose.

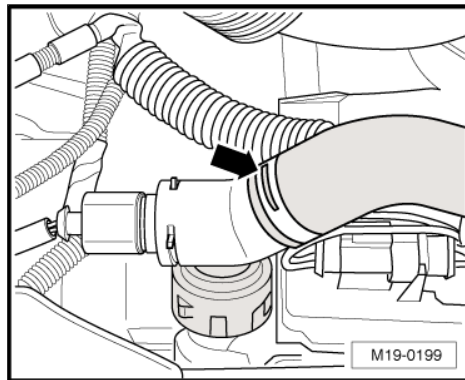
Coolant will run onto the bumper cover if the quick-release coupling on the radiator connection is pulled off.

Filling



Note

- ◆ *The water portion of the coolant influences the effectiveness of the coolant.*
- ◆ *Volkswagen has decided to define the water quality used in the cooling system based on the different mixtures and country and regional requirements.*
- ◆ *Use distilled water.*
- ◆ *For this reason, we recommend using distilled water for older models when adding coolant or filling coolant for the first time.*
- ◆ *On newer models (from MY 2010), distilled water is required.*



Caution

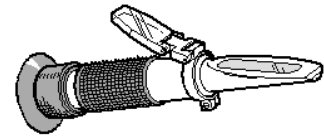
Only use distilled water for mixing with G12 plus plus. Using distilled water provides optimum corrosion protection.



Note

- ◆ On vehicles from MY 2008, only coolant additive G 12 Plus-Plus conforming to TL VW774 G may be used.
- ◆ On vehicles through MY 2007, coolant additive G 12 plus conforming to TL VW774 F and G 12 plus-plus conforming to TL VW774 G may be used.
- ◆ G 12 plus plus may be mixed with the previous coolant additive G12 plus. Both are colored purple.
- ◆ Coolant additives marked with "Conforms to TL VW774 G" or "Conforms to TL VW774 F" prevent freezing and corrosion damage and scaling and they increase the boiling point. For this reason the system must be filled all year round with frost and corrosion protection additives.
- ◆ Because of its high boiling point, the coolant contributes to engine reliability under heavy loads, particularly in countries with tropical climates.
- ◆ Freeze protection must be assured to about -25 °C (in arctic climatic countries to about -35 °C).
- ◆ The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The coolant additive portion must be at least 40%.
- ◆ If greater frost protection is required for climatic reasons, the amount of coolant additive can be increased, but only up to 60% (frost protection down to approximately -40 °C (-40 °F)), otherwise frost protection and cooling effectiveness will be reduced.
- ◆ The Refractometer -T10007a- is recommended for determining the current freeze protection density.
- ◆ Do not use the old coolant again if replacing the radiator, heater core, cylinder head or cylinder head gasket.

T1 0007



W00-0689

Recommended mixture ratios:

Frost protection to	Anti-freeze	G 12 plus ¹⁾ G 12 plus-plus ¹⁾	Distilled water ¹⁾
-25 °C (-13 °F)	40 %	3.6L	5.4L
-35 °C (-31 °F)	50 %	4.5L	4.5L

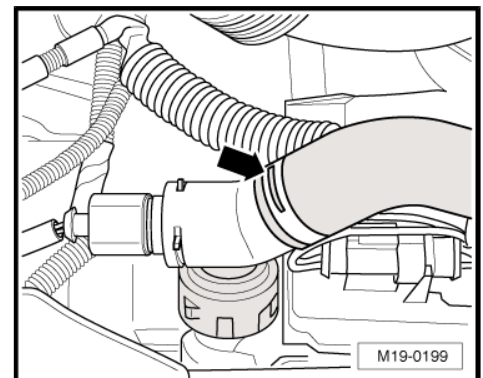
¹⁾ The quantity of coolant can vary depending upon the vehicle equipment.

- Connect the coolant hose to the connection and secure it using a spring clamp.
- Install the noise insulation. Refer to ⇒ Body Exterior; Rep. Gr. 50 ; Noise Insulation .

Filling with Cooling System Charge Kit - VAS6096-

- Install the Cooling System Tester - Adapter - VAG1274/8- onto the expansion tank.
- Fill coolant circuit using Cooling System Charge Kit - VAS6096- . Refer to Operating Instructions for Cooling System Charge Kit.

Filling without Cooling System Charge Kit - VAS6096-



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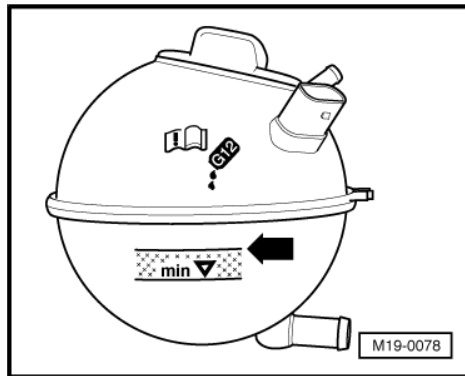
- Slowly fill the coolant to the upper marking of the hatched field -arrow- on the expansion tank.
- Close the reservoir.
- Turn off the heater and air conditioning.
- Start engine and maintain an engine speed of about 2000 RPM for approximately 3 minutes.
- Let engine run until the fan starts up.



WARNING

Hot steam may escape when opening the reservoir.

- ◆ *Wear protective eyewear and protective clothing to prevent eye injury and scalding.*
- ◆ *Cover the cap with a cloth and open very carefully.*



- Check coolant level and fill as necessary.
- ◆ With engine at operating temperature, coolant level must lie at top marking of hatched area -arrow-.
- ◆ With engine cold, coolant level should be located approximately in the center of hatched area.

4.2 Coolant Pump

Special tools and workshop equipment required

- ◆ Engine Support Bridge - 10-222A-
- ◆ Engine Support Bridge - Engine Support 3 - 10-222A/3-
- ◆ Engine Support Bridge - Engine Support Feet - 10-222A/8-
- ◆ Engine/Gearbox Support Shackle (2 pc.) - 10-222A/12-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.*

Removing

- Remove the engine cover with air filter. Refer to ➔ [“4.1 Engine Cover with Air Filter”, page 216](#) .
- Remove the battery. Refer to ➔ Electrical Equipment; Rep. Gr. 27 ; Battery; Removing and Installing; Vehicles with Gasoline Engine .



- Open the E-box cover -1- and disconnect the wire -2-.
- Remove bolts -arrows- and remove battery holder from the vehicle.



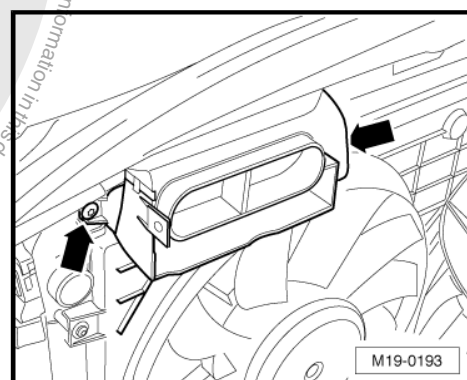
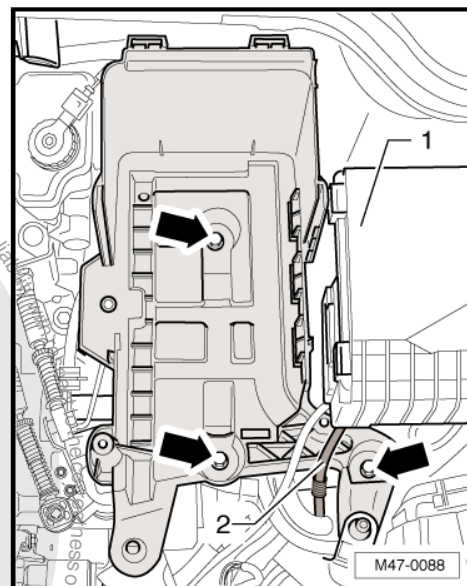
WARNING

Hot steam may escape when opening the reservoir.

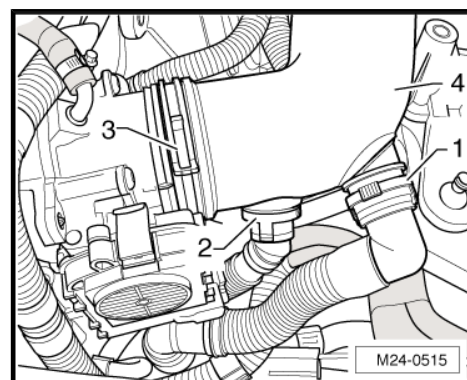
- ◆ *Wear protective eyewear and protective clothing to prevent eye injury and scalding.*
- ◆ *Cover the cap with a cloth and open very carefully.*

Drain the coolant. Refer to
⇒ ["4.1 Coolant, Draining and Filling", page 123](#) .

- Remove the air guide from the lock carrier -arrows-.



- Remove the intake hose -4-. To do so, disconnect the air hoses -1- and -2- (compress the spring clip) and remove spring clamp -3-.
- Remove the right front wheel housing liner front and rear sections. Refer to ⇒ Body Exterior; Rep. Gr. 66 ; Wheel Housing Liner .
- Remove the ribbed belt for generator and coolant pump. Refer to ⇒ ["4.1 Ribbed Belt", page 43](#) .





- Remove the four nuts -2- and the bolts -3-.
- Remove the exhaust pipe -1- from the manifold and tie it securely to the side. Refer to
⇒ [“4.1 Front Exhaust Pipe with Catalytic Converter, Removing and Installing”, page 246](#) .



Note

Flex joint in front exhaust pipe must not be bent more than 10 ° otherwise it may be damaged.

- Remove the pendulum support. Refer to ⇒ Suspension, Wheels, Steering; Rep. Gr. 40 ; Overview: Subframe, Stabilizer, Control Arm; Removing and Installing .

Vehicles with a manual transmission

- Remove shift mechanism from transmission. Refer to ⇒ Manual Transmission; Rep. Gr. 34 ; Gearshift Mechanism, Servicing .

Vehicles with an automatic transmission

- Remove the selector lever cable from the transmission. Refer to ⇒ Automatic Transmission; Rep. Gr. 37 ; Selector Mechanism .

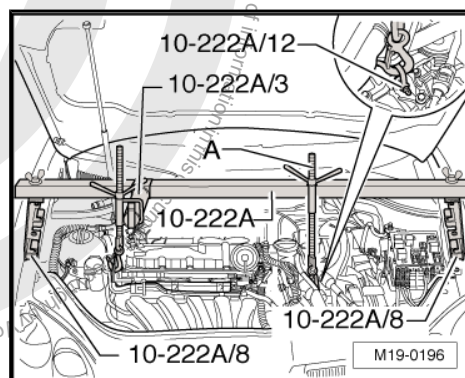
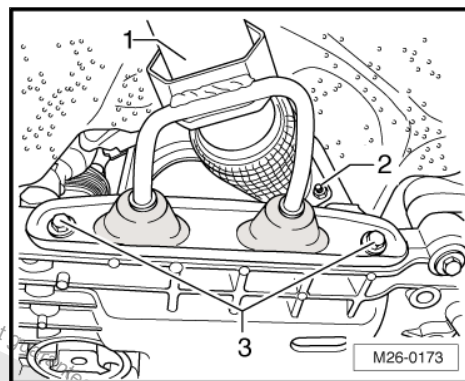
Continuation for all vehicles

- Install the Engine Support Bridge - 10-222A- with the Engine Support Bridge - Engine Support Feet - 10-222A/8- and support the engine/transmission assembly in installation position using Engine Support Bridge - Engine Support 3 - 10-222A/3- and Engine/Gearbox Support Shackle (2 pc.) - 10-222A/12- .

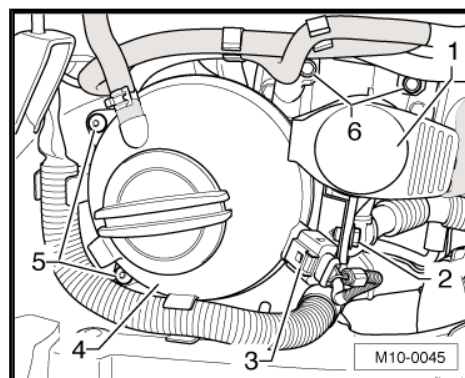


Note

- ♦ *Illustration shows the arrangement with automatic transmission.*
- ♦ *On vehicles with manual transmission, the spindle -A- is to be located toward rear and secured to reinforcement brace of transmission.*



- Remove the bolt -2- and move the windshield washer reservoir -1- toward the front.
- Remove the bolts -6- and disconnect the connector -3-.
- Remove the bolts -5- and lay the coolant expansion tank on the engine, with the hoses still connected.



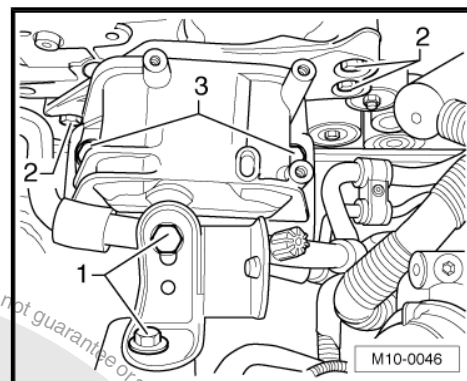


- Remove the bolts -1-, -2- and -3- and remove the engine mount.

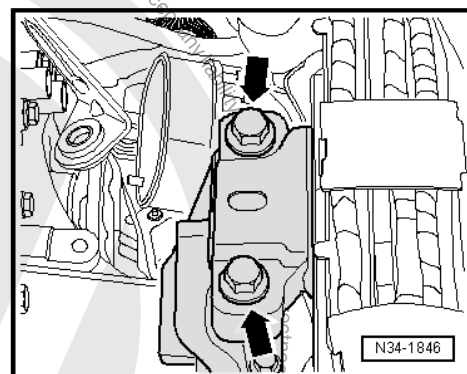


Note

The rear bolt -2- is accessible through a hole in the wheel housing.



- Remove transmission-side subframe bracket bolts -arrows-.
- Slide engine as far as possible toward front and toward left.

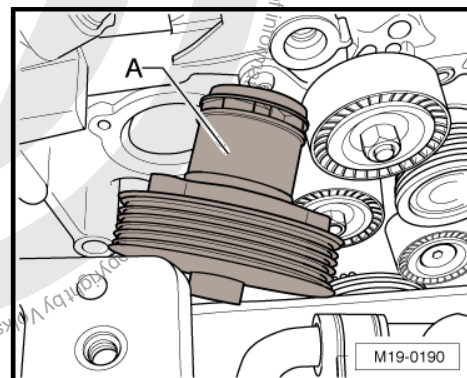


- Remove the 3 bolts -item 23- ⇒ [Item 23 \(page 115\)](#) and the coolant pump -A-, as illustrated.

Installing

Install in reverse order of removal. Note the following:

- ◆ Pay attention to the installed position of the coolant pump. The plug inside the housing faces downward.
- ◆ Fill the coolant. Refer to ⇒ ["4.1 Coolant, Draining and Filling", page 123](#).
- ◆ Install the battery. Refer to ⇒ Electrical Equipment; Rep. Gr. 27 ; Battery, Removing and Installing; Vehicles with Gasoline Engine .



Tightening specifications:

Component	Nm
Install subframe mount	⇒ "1 Description and Operation", page 6
Coolant pump to cylinder block	10

4.3 Coolant Thermostat

Special tools and workshop equipment required

- ◆ Refractometer - T10007A-
- ◆ Drip Tray - VAG1306- or Shop Crane - Drip Tray - VAS6208-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Hose Clip Pliers



Note

Checking coolant regulator -item 17- ➔ [Item 17 \(page 114\)](#).

Removing



WARNING

Hot steam may escape when opening the reservoir.

- ◆ *Wear protective eyewear and protective clothing to prevent eye injury and scalding.*
- ◆ *Cover the cap with a cloth and open very carefully.*

- Drain the coolant. Refer to ➔ ["4.1 Coolant, Draining and Filling", page 123](#) .
- Remove the engine cover with air filter. Refer to ➔ ["4.1 Engine Cover with Air Filter", page 216](#) .
- Remove the intake manifold. Refer to ➔ ["4.3 Intake Manifold", page 218](#) .
- Insert guide tube for oil dipstick into cylinder block again and screw it tightly so that no escaping coolant can run into the engine.
- Place a suitable container under coolant regulator housing to catch coolant flowing out.
- Remove the bolts -arrows-, pull off the connections -A- and then remove the coolant thermostat.

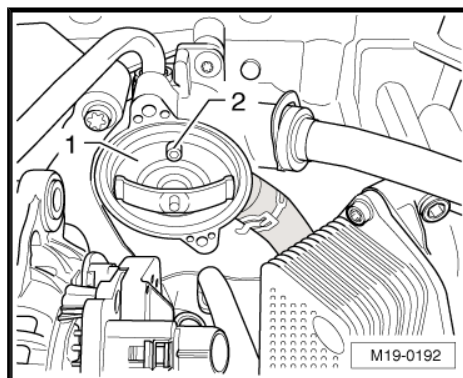
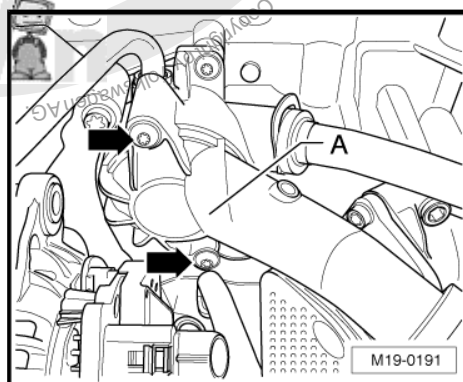
Installing

Install in reverse order of removal. Note the following:

- ◆ Replace sealing ring -item 18- ➔ [Item 18 \(page 115\)](#) and O-ring -item 16- ➔ [Item 16 \(page 114\)](#) .
- ◆ Note installation position of coolant regulator -1-. Valve -2- must point upward.
- ◆ Fill the coolant. Refer to ➔ ["4.1 Coolant, Draining and Filling", page 123](#) .

Tightening Specification:

Component	Nm
Connection to coolant thermostat housing	5

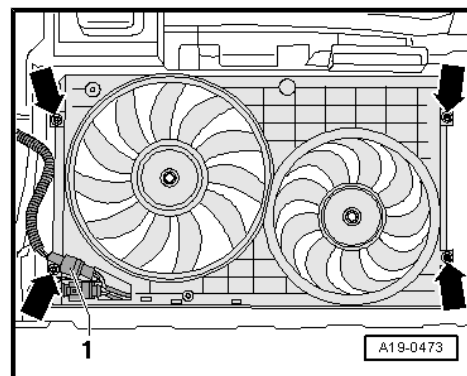




4.4 Coolant Fan - V7- and Coolant Fan 2 - V177-

Removing

- Remove the noise insulation. Refer to ➤ Body Exterior; Rep. Gr. 50 ; Noise Insulation .
- Unclip lower coolant hose from intake air elbow.
- Disconnect the connector -1- and remove the bolts from the air shroud -arrows-.
- Remove intake air elbow downward.



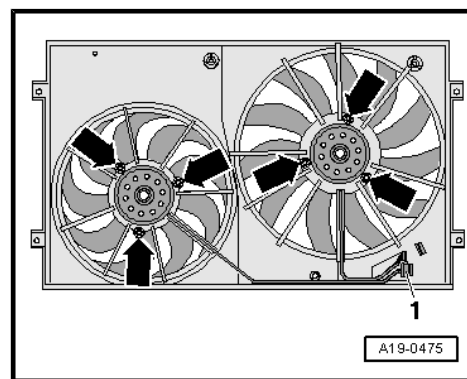
- Disconnect the connector -1- and free up the wires. The installed position of the connector varies from the picture.
- Remove the nuts -arrows- and the fans.

Installing

Install in reverse order of removal. Note the following:

Tightening specifications:

Component	Nm
Coolant fan to intake air elbow	5
Air intake elbow to cooler	5



4.5 Radiator

Special tools and workshop equipment required

- ◆ Refractometer - T10007A-
- ◆ Drip Tray - VAG1306- or Shop Crane - Drip Tray - VAS6208-
- ◆ Hose Clip Pliers
- ◆ Cooling System Charge Kit - VAS6096-
- ◆ Cooling System Tester - Adapter - VAG1274/8-

Removing

Remove the air shroud and the radiator fans. Refer to ➤ ["4.4 Coolant Fan V7 and Coolant Fan 2 V177", page 131](#) .

Drain the coolant. Refer to ➤ ["4.1 Coolant, Draining and Filling", page 123](#) .

- Remove the front bumper. Refer to ➤ Body Exterior; Rep. Gr. 63 ; Front Bumper



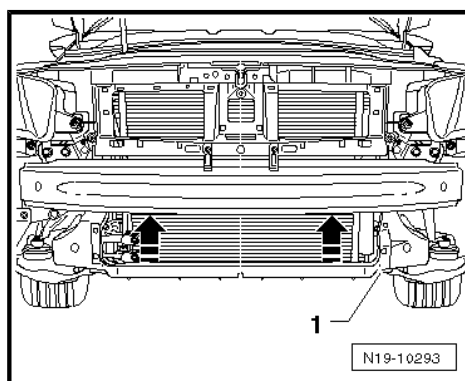
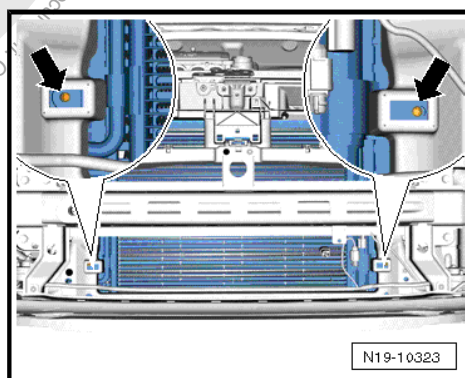
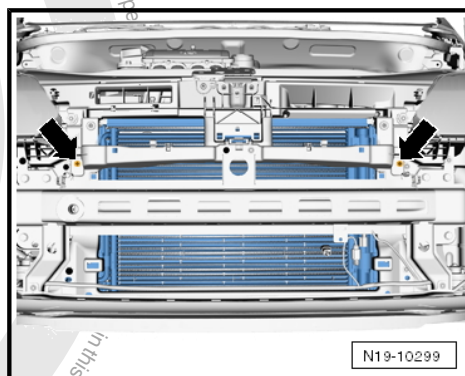
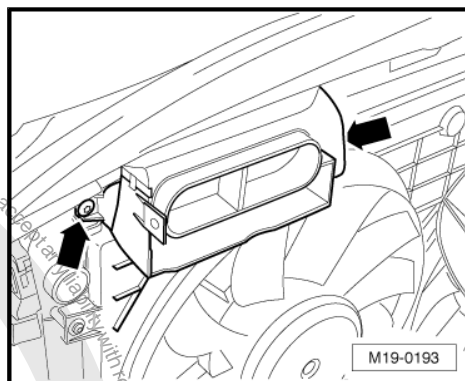
- Remove the intake air connection from the lock carrier -arrows-.
- Disconnect the coolant connections on the top and bottom of the radiator (quick acting couplings).



Caution

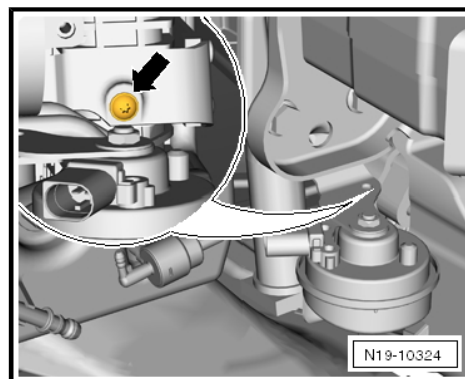
To prevent damage to the condenser and the refrigerant lines, do not stretch, kink or bend the pipes and hoses.

- Remove the bolts -arrows- from the radiator mount.
- Remove the lower bolts -arrows- for the condenser.
- Move the cooler and condenser toward the rear and out of the lower mount. While doing this, pull the lock carrier on the left mount -1- slightly downward.





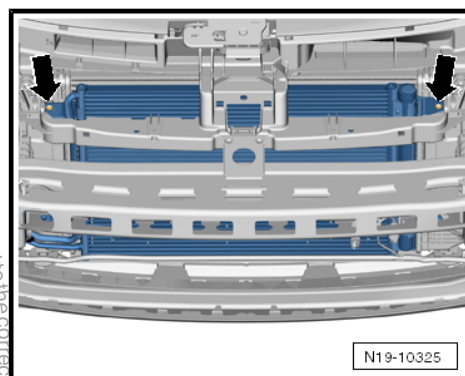
- Remove the bolts for the refrigerant lines on the right side of the radiator -arrow-.



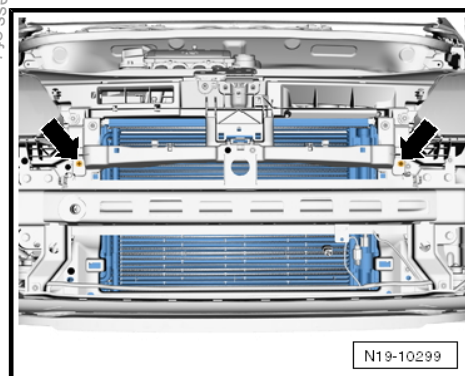
- Remove the upper bolts -arrows- for the condenser.
- Take radiator up and out.

Installing

- Install the radiator from above and secure it to the condenser.
- Install the radiator and condenser in the lower mounts.



- Place the upper radiator mount on the radiator and secure it with the lock carrier -arrows-.
- Install the front bumper. Refer to ➤ Body Exterior; Rep. Gr. 63 .
- Connect the coolant hoses on the top and bottom of the radiator using their quick-release fasteners.
- Secure the intake air connection on the lock carrier.
- Remove the air shroud with the coolant fans. Refer to ➤ "4.4 Coolant Fan V7 and Coolant Fan 2 V177" , page 131 .
- Fill the coolant. Refer to ➤ "4.1 Coolant, Draining and Filling" , page 123 .



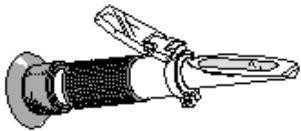
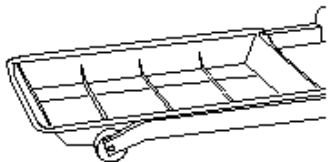

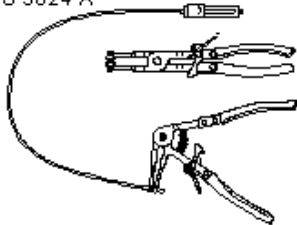
Tightening specifications:

Component	Nm
Radiator mounting to lock carrier	7
Condenser to radiator	5
Air intake elbow to cooler	5

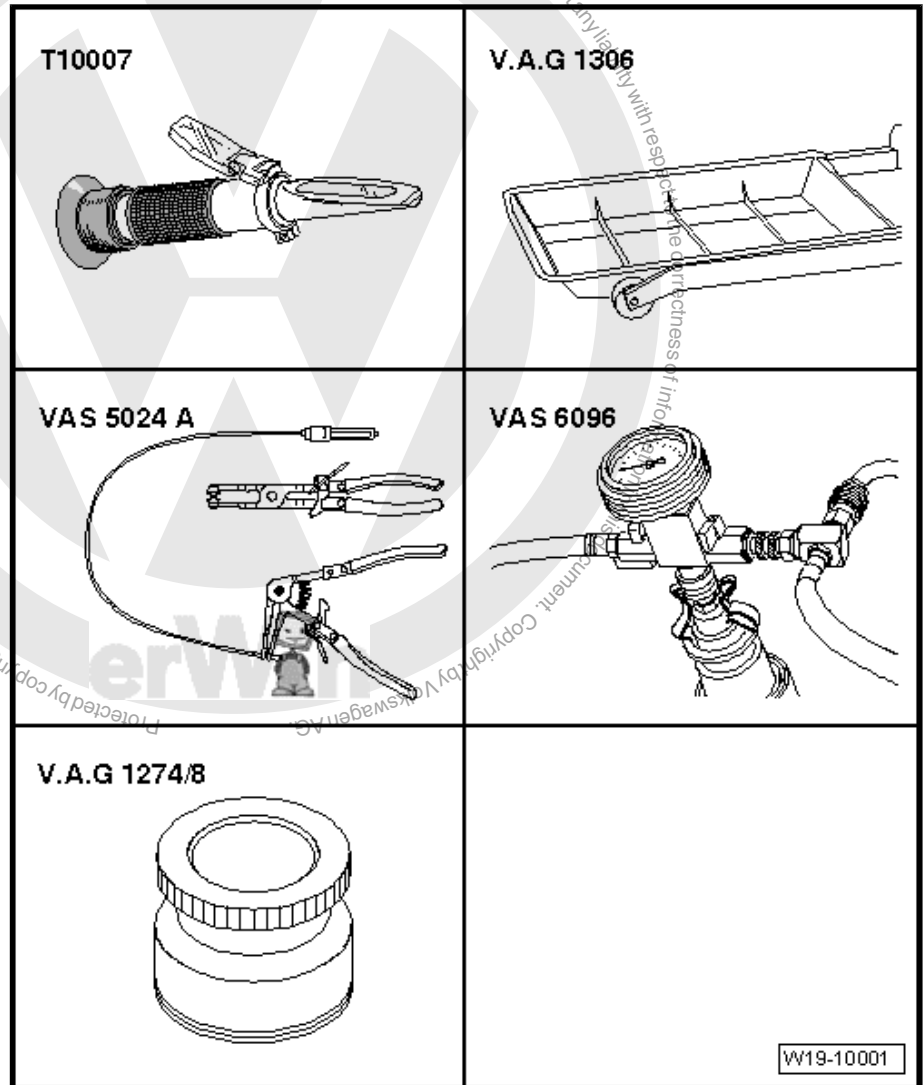


5 Special Tools

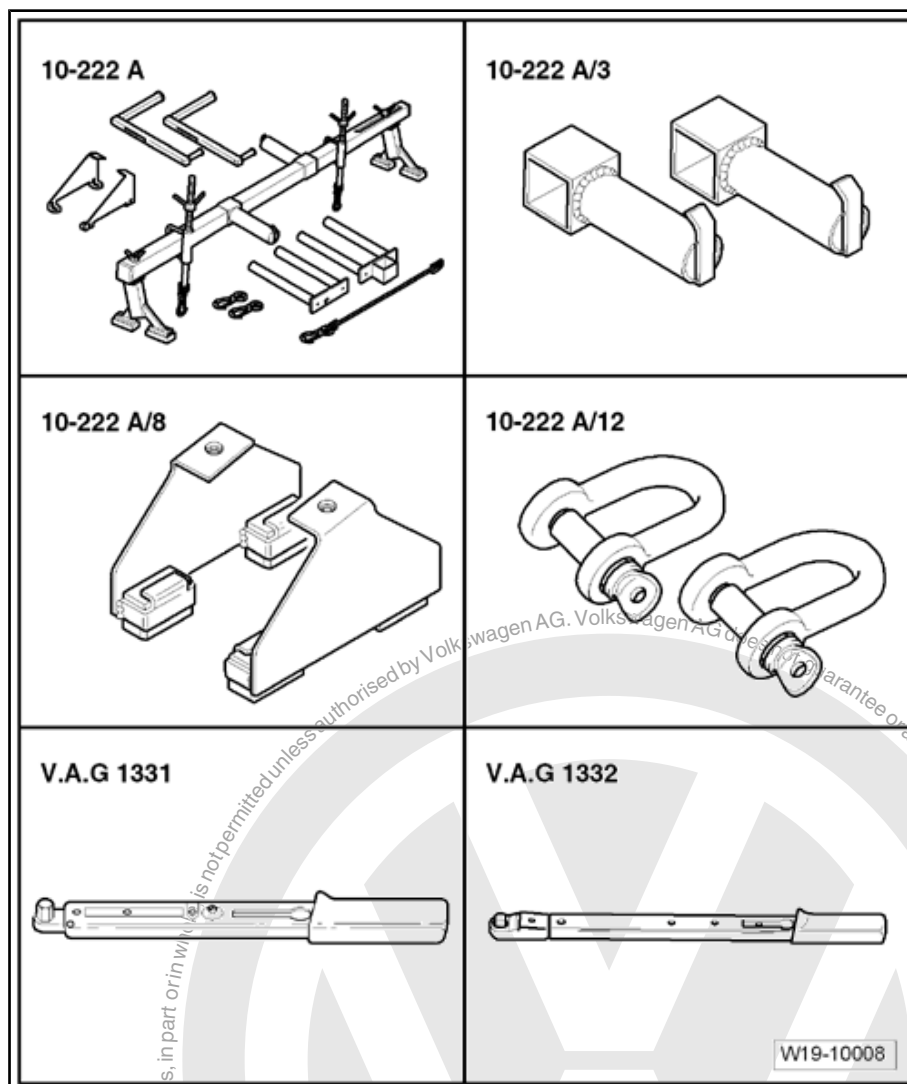
Special tools and workshop equipment required

<p>T10007</p> 	<p>V.A.G 1306</p> 
<p>V.A.G 1331</p> 	<p>VAS 5024 A</p> 
<p>VW19-0045</p>	

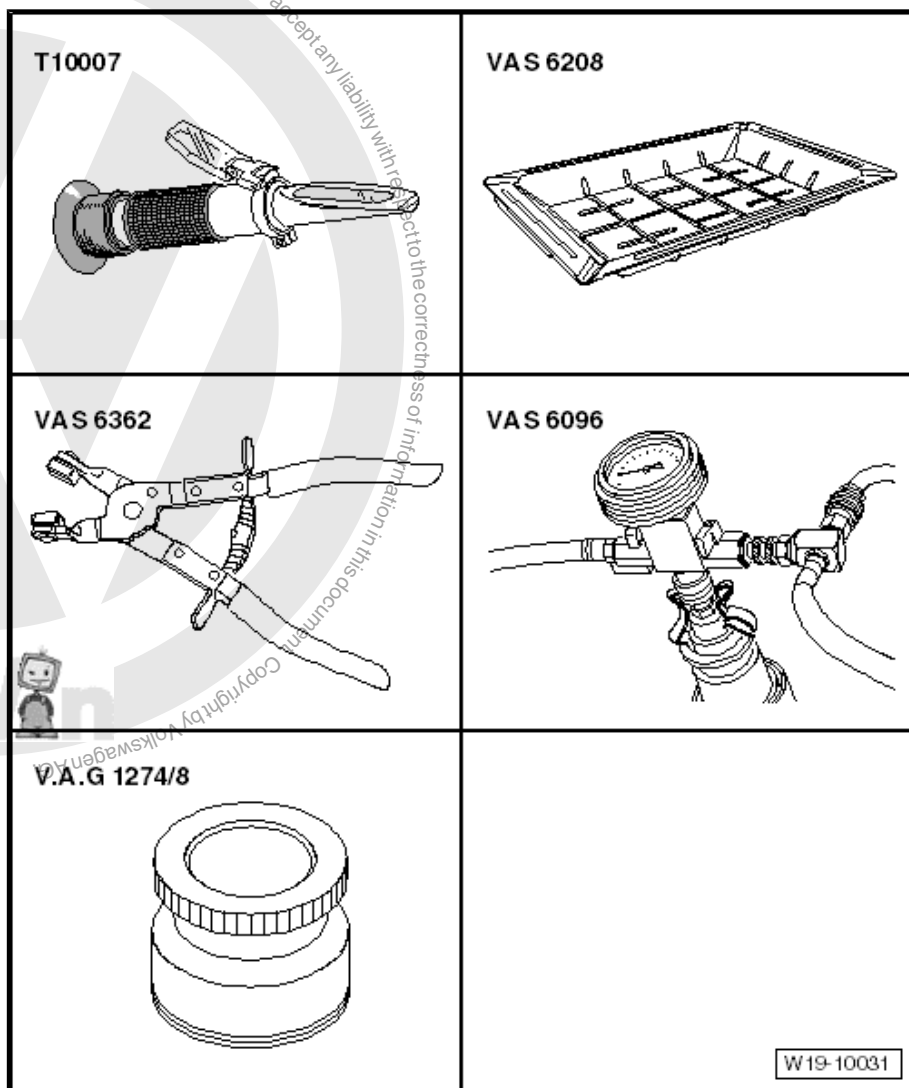
- ◆ Refractometer - T10007A-
- ◆ Drip Tray - VAG1306- or Shop Crane - Drip Tray - VAS6208-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Hose Clip Pliers - VAS5024A-



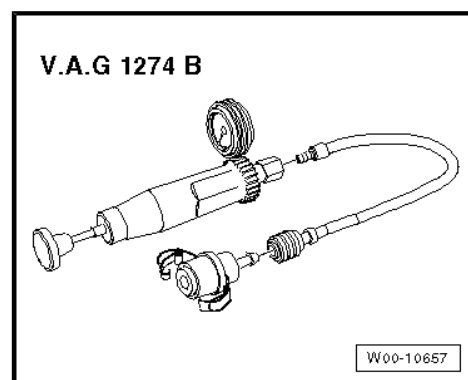
- ◆ Refractometer - T10007A-
- ◆ Drip Tray - VAG1306- or Shop Crane - Drip Tray - VAS6208-
- ◆ Cooling System Charge Kit - VAS6096-
- ◆ Cooling System Tester - Adapter - VAG1274/8-
- ◆ Hose Clip Pliers - VAS5024A-



- ◆ Engine Support Bridge - 10-222A-
- ◆ Engine Support Bridge - Engine Support 3 - 10-222A/3-
- ◆ Engine Support Bridge - Engine Support Feet - 10-222A/8-
- ◆ Engine/Gearbox Support Shackle (2 pc.) - 10-222A/12-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-

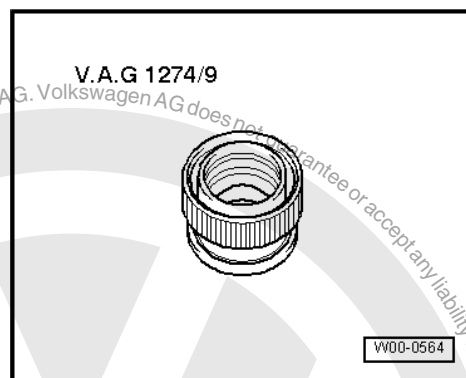


- ◆ Refractometer - T10007A-
- ◆ Drip Tray - VAG1306- or Shop Crane - Drip Tray - VAS6208-
- ◆ Hose Clip Pliers - VAS6362-
- ◆ Cooling System Charge Kit - VAS6096-
- ◆ Cooling System Tester - Adapter - VAG1274/8-
- ◆ Cooling System Tester - VAG1274B-





◆ Cooling System Tester - Adapter - VAG1274/9-





20 – Fuel Supply

1 General Information

⇒ [“1.1 Safety Precautions, Working on Fuel Supply System”, page 139](#)

⇒ [“1.2 Clean Working Conditions”, page 140](#)

⇒ [“1.3 EPC System Function”, page 140](#)

BGP, BGQ, CBTA and CBUA

⇒ [“1.4 EVAP System Function”, page 141](#)

BTK and CCCA ⇒ [“1.5 EVAP System Function”, page 141](#)

1.1 Safety Precautions, Working on Fuel Supply System



WARNING

Fuel system is under pressure!

- ◆ *Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.*
- ◆ *Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.*

For safety reasons, switch off the current to the fuel pump before opening the fuel system. Otherwise, the fuel pump will activate when the driver door opens or when the ignition switches on. Switch the power supply off in one of the following ways:

- ◆ *Disconnecting the battery*

or

- ◆ *Remove the Transfer Fuel Pump - G6- fuse.*

or

- ◆ *Disconnect the connector on the fuel delivery unit flange.*



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.*

Always observe the following when removing and installing the fuel level sensor or the fuel pump(fuel delivery unit) from full or partially filled fuel tanks.

- ◆ Before starting work, switch on exhaust extraction system and place an extraction hose close to the installation opening of fuel tank to extract escaping fuel fumes. If no exhaust extrac-



tion system is available, a radial fan (as long as motor is not in air flow) with a displacement greater than 15 m³/h can be used.

- ◆ Do not let fuel come in contact with bare skin. Wear fuel-resistant gloves.

1.2 Clean Working Conditions

When working on the fuel supply/injection system, pay careful attention to the following "5 rules" of cleanliness:

- ◆ Thoroughly clean the connecting points and the surrounding area before loosening.
- ◆ Place the removed parts on a clean surface and cover them. Only use lint-free cloths!
- ◆ Carefully cover or seal opened components if the repair will not be done immediately.
- ◆ Install only clean parts: remove the replacement parts from their packaging just before installing them. Do not use parts that have been stored loose (for example, in tool boxes etc.).
- ◆ When the fuel system is open: avoid working with compressed air if possible. Do not move vehicle unless absolutely necessary.

1.3 EPC System Function

For EPC, the throttle valve is not operated by a cable from the accelerator pedal. There is no mechanical connection between the gas pedal and the throttle valve.

The position of the accelerator pedal is transmitted to the engine control module via two accelerator pedal position senders (adjustable resistances, accommodated in one housing), that are connected to the accelerator pedal.

The position of the accelerator pedal (driver controlled) is a main input for the engine control module.

Operation of the throttle valve occurs via an electric motor (throttle valve actuator) in the throttle valve control module. This is true across the entire engine speed and engine load spectrum.

The throttle valve is operated by the throttle drive according to the instructions of the Engine Control Module (ECM).

With the engine at standstill and the ignition switched on, the Engine Control Module (ECM) activates the throttle valve actuator precisely according to the specifications of the Throttle Position (TP) Sensor. This means, if the accelerator pedal is depressed half way, the throttle drive opens the throttle valve to the same degree; i.e. throttle valve is then opened approximately half way.

With engine running (under load) the engine control module can open and close the throttle valve independently of the accelerator pedal position sensor.

This means, for example, that the throttle valve could be fully opened even though the accelerator pedal has only been depressed half way. This has the advantage of preventing torque losses at the throttle valve.

After evaluating the torque requirements of the various components (such as the A/C system, automatic transmission, ABS/ESP, etc.), the engine control module calculates the optimal throttle valve opening angle for the current situation.

Aside from that, it results in clearly better pollutant output and consumption values under certain load conditions.



"EPC" is a system containing all components that contribute to determining, controlling and monitoring the throttle valve position, for example Throttle Position (TP) Sensor, Throttle Valve Control Module, EPC warning light, Engine Control Module (ECM).

1.4 EVAP System Function

Depending upon air pressure and ambient temperature - more or less fuel vapors will form in the fuel tank.

The EVAP canister system prevents these HC emissions from entering the atmosphere.

Fuel vapors penetrate into EVAP canister via gravity valves integrated in the fuel tank.

The activated charcoal in the canister stores these gases like a sponge.

While driving, with oxygen sensor control active (engine warm), the EVAP Canister Purge Regulator Valve 1 - N80- (also called the regeneration valve) is activated by the engine control module in pulses depending on the load and engine speed. The opening time is dependent on input signals.

During the cleansing process (regeneration of activated charcoal), the intake manifold pressure sucks fresh air through the air openings of the EVAP canister. Fuel vapor temporarily saved in the activated charcoal and fresh air are proportionately supplied via the EVAP Canister Purge Regulator Valve 1 - N80- to be burned.

When no voltage is applied (for example, wiring open circuit), the solenoid valve is closed. The EVAP canister is not purged.

Leak Detection Function Description

The EVAP canister system (including fuel tank) is equipped with a leak diagnostic that detects leaks (leaks) in the system.

The diagnosis operates by pressurizing the system and should detect leaks where the damage exceeds 1 mm in diameter.

During the diagnostics, the Leak Detection Pump - V144- generates a positive pressure of approximately 30 mbar in the EVAP system. The pump is switched off once the pressure is reached once. When the pressure falls to below a certain figure, the pump will switch on again. On Board Diagnostic monitors the switch intervals and stores a DTC in DTC memory if the intervals are too short.

1.5 EVAP System Function

Depending upon air pressure and ambient temperature - more or less fuel vapors will form in the fuel tank.

The EVAP canister system prevents these HC emissions from entering the atmosphere.

With quantity restrictions, fuel vapors travel from the highest point of the tank via the gravity valve (closed at a tilt of 45°) and the pressure retention valve to the EVAP canister.

The activated charcoal in the canister stores these gases like a sponge.

While driving, with oxygen sensor control active (engine warm), EVAP Canister Purge Regulator Valve 1 - N80- , (also called the regeneration valve) is activated by the engine control module in pulses dependent on load and engine speed. The opening time is dependent on input signals.

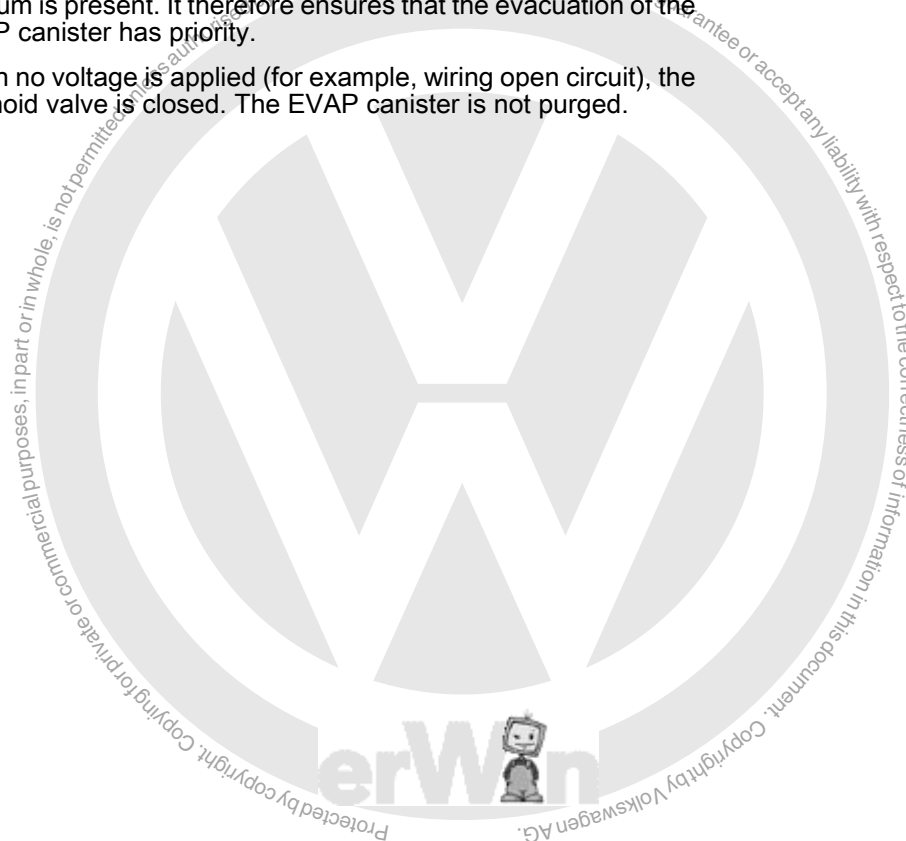
When purging (recovery of the activated charcoal), the suction tube vacuum sucks fresh air in through the ventilation opening on the underside of the EVAP canister. The fuel vapors stored



amongst the activated charcoal and fresh air are proportionately supplied to be burned.

The pressure retention valve prevents fuel vapors from being sucked out of the tank when the Evaporative Emission (EVAP) canister purge regulator valve is opened and an intake manifold vacuum is present. It therefore ensures that the evacuation of the EVAP canister has priority.

When no voltage is applied (for example, wiring open circuit), the solenoid valve is closed. The EVAP canister is not purged.





2 Description and Operation

⇒ [“2.1 Overview - Fuel Tank”, page 143](#)

⇒ [“2.2 Overview - Fuel Tank”, page 145](#)

⇒ [“2.3 Overview - Fuel Filter with Attachments”, page 147](#)

⇒ [“2.4 Overview - Accelerator Pedal Module”, page 148](#)

BGP, BGQ, CBTA and CBUA

⇒ [“2.5 Overview - EVAP System”, page 149](#)

BTK and CCCA ⇒ [“2.6 Overview - EVAP System”, page 153](#)

2.1 Overview - Fuel Tank

1 - Bolt

2 - Ground Connection

- ☐ Make sure it is secure

3 - Vacuum Line

- ☐ To Leak Detection Pump - V144-

4 - Bolt

- ☐ 11 Nm

5 - Rivet

6 - Shield

- ☐ Riveted to lower clamp at factory
- ☐ When replacing fuel tank, set protective plate on filler tube and rivet clamp (holes on protective plate must coincide with holes on filler tube).

7 - Wiring Guide

- ☐ For the ABS line
- ☐ Clipped to the shield

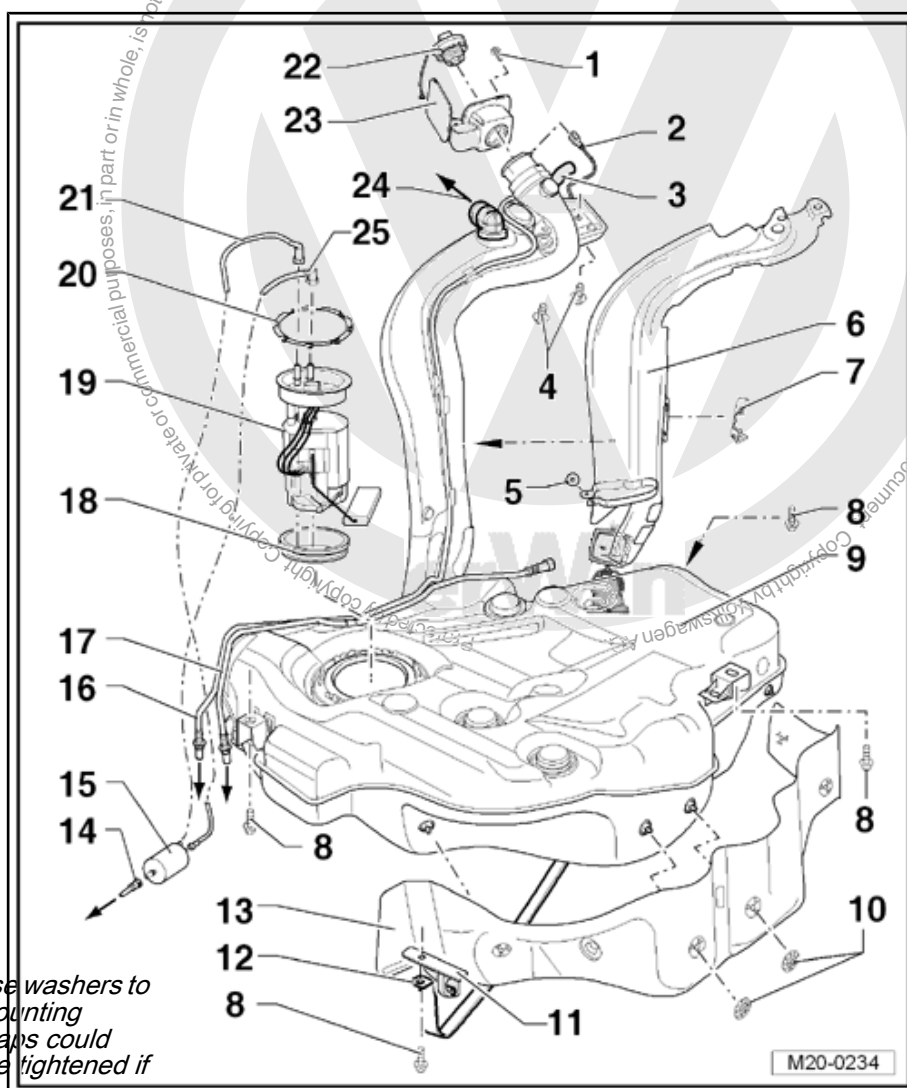
8 - Bolt

- ☐ 26 Nm
- ☐ Replace



Note

Only use bolts with loose washers to secure the fuel tank mounting straps. The tension straps could twist when the bolts are tightened if other bolts are used.



9 - Fuel Tank

- ☐ Removing and installing. Refer to ⇒ [“4.4 Fuel Tank”, page 181](#) .

10 - Lock Washer

11 - Exhaust System Bracket

12 - Mounting Strap

- ☐ Note the installation position



13 - Shield

14 - Supply Line

- ☐ To fuel rail
- ☐ Make sure it is secure

15 - Fuel Filter

- ☐ Installed position: the arrow points in the flow direction
- ☐ Fuel Filter with Attachments. Refer to ⇒ [“2.3 Overview - Fuel Filter with Attachments”, page 147](#) .
- ☐ Removing and installing. Refer to ⇒ [“4.5 Fuel Filter”, page 183](#) .

16 - Vacuum Line

- ☐ From the Leak Detection Pump - V144- to the intake manifold
- ☐ Clipped to the fuel tank
- ☐ Make sure it is secure

17 - Breather Line

- ☐ From EVAP canister to EVAP Canister Purge Regulator Valve 1 - N80-
- ☐ Clipped to the fuel tank
- ☐ Make sure it is secure

18 - Seal

- ☐ Replace
- ☐ Install the dry seal into the opening in the fuel tank
- ☐ Only coat inner part with fuel when installing fuel delivery unit.

19 - Fuel Delivery Unit

- ☐ Removing and installing. Refer to ⇒ [“4.2 Fuel Delivery Unit”, page 177](#)
- ☐ Fuel Pump, Checking. Refer to ⇒ [“3.1 Fuel Pump, Checking”, page 155](#) .
- ☐ Note installation position in fuel tank. Refer to
⇒ [Fig. “Installed position of fuel delivery unit” , page 145](#)
- ☐ With Fuel Level Sensor - G-
- ☐ Fuel Level Sensor - G- , Removing and Installing. Refer to ⇒ [“4.3 Fuel Level Sensor G ”, page 179](#) .
- ☐ Clean the screen if it is dirty.

20 - Locking Ring

- ☐ 110 Nm
- ☐ Make sure it is secure
- ☐ Remove and install with the Wrench - Fuel Sending Unit - T10202-

21 - Return Line

- ☐ Blue
- ☐ Attached to the side of the fuel tank
- ☐ Make sure it is secure

22 - Cap

- ☐ Engine codes BGP and CBTA: threaded connection
- ☐ Engine codes BGQ and CBUA: bayonet connection
- ☐ Replace the seal if damaged.

23 - Fuel Filler Door Unit

- ☐ With rubber cup
- ☐ Removing and Installing. Refer to ⇒ Body Exterior; Rep. Gr. 55 ; Fuel Filler Door Unit

24 - To EVAP canister

25 - Supply Line

- ☐ Black
- ☐ Attached to the side of the fuel tank



- ☐ Make sure it is secure

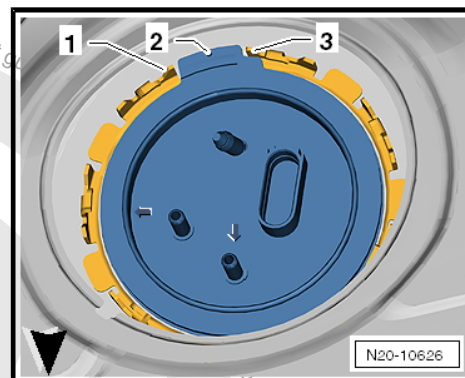
Installed position of fuel delivery unit

The tab -2- on fuel delivery unit must lie between tabs -1- and -3-.



Note

- ◆ The -arrow- points in the direction of travel.
- ◆ Fuel delivery unit can only be installed in this position.



2.2 Overview - Fuel Tank

1 - Bolt

2 - Cap

- ☐ Replace the seal if damaged.

3 - Ground Connection

- ☐ Make sure it is secure

4 - Bolt

- ☐ 11 Nm

5 - Wiring Guide

- ☐ For the ABS line

6 - Bolt

- ☐ 26 Nm
- ☐ Replace



Note

Only use bolts with loose washers to secure the fuel tank mounting straps. The tension straps could twist when the bolts are tightened if other bolts are used.

7 - Fuel Tank

- ☐ Removing and installing. Refer to ["4.4 Fuel Tank", page 181](#).

8 - Lock Washer

9 - Exhaust System Bracket

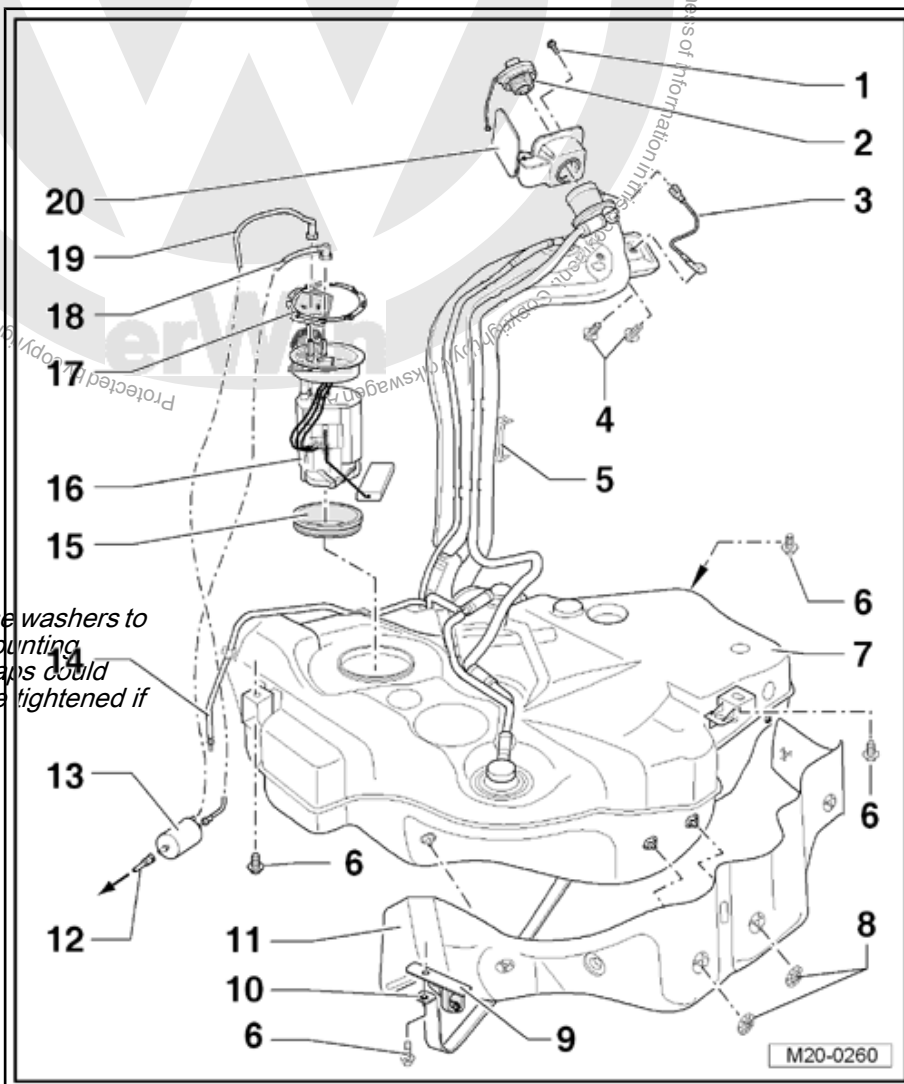
10 - Mounting Strap

- ☐ Note the installation position

11 - Shield

12 - Supply Line

- ☐ To fuel rail
- ☐ Make sure it is secure





13 - Fuel Filter

- ☐ Installed position: the arrow points in the flow direction
- ☐ Fuel Filter with Attachments. Refer to ⇒ [“2.3 Overview - Fuel Filter with Attachments”, page 147](#) .
- ☐ Removing and installing. Refer to ⇒ [“4.5 Fuel Filter”, page 183](#) .

14 - Breather Line

- ☐ To the EVAP canister
- ☐ Attached to the side of the fuel tank
- ☐ Make sure it is secure

15 - Seal

- ☐ Replace
- ☐ Install the dry seal into the opening in the fuel tank
- ☐ Only coat inner part with fuel when installing fuel delivery unit.

16 - Fuel Delivery Unit

- ☐ Removing and installing. Refer to ⇒ [“4.2 Fuel Delivery Unit”, page 177](#) .
- ☐ Fuel Pump, Checking. Refer to ⇒ [“3.1 Fuel Pump, Checking”, page 155](#) .
- ☐ Note installation position in fuel tank. Refer to ⇒ [Fig. “Installed position of fuel delivery unit” , page 146](#)
- ☐ With Fuel Level Sensor - G-
- ☐ Fuel Level Sensor - G- , Removing and Installing. Refer to ⇒ [“4.3 Fuel Level Sensor G”, page 179](#) .
- ☐ Clean the screen if it is dirty.

17 - Locking Ring

- ☐ 110 Nm
- ☐ Make sure it is secure
- ☐ Remove and install with the Wrench - Fuel Sending Unit - T10202-

18 - Supply Line

- ☐ Black
- ☐ Attached to the side of the fuel tank
- ☐ Make sure it is secure

19 - Return Line

- ☐ Blue
- ☐ Attached to the side of the fuel tank
- ☐ Make sure it is secure

20 - Fuel Filler Door Unit

- ☐ With rubber cup
- ☐ Removing and Installing. Refer to ⇒ Body Exterior; Rep. Gr. 55 ; Fuel Filler Door Unit

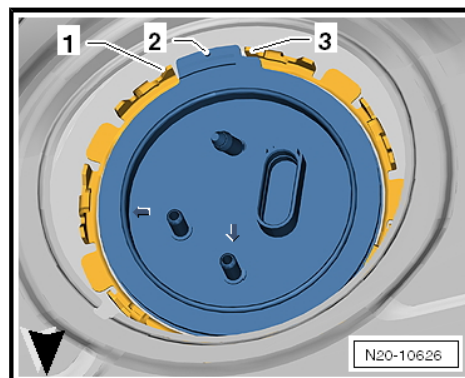
Installed position of fuel delivery unit

The tab -2- on fuel delivery unit must lie between tabs -1- and -3-.



Note

- ◆ The -arrow- points in the direction of travel.
- ◆ Fuel delivery unit can only be installed in this position.





2.3 Overview - Fuel Filter with Attachments



Note

From 10/2005, the fuel pressure regulator is integrated into the fuel filter and cannot be replaced separately.

1 - Fuel Filter

- ☐ New version with integrated fuel pressure regulator
- ☐ Direction of flow is marked with arrows
- ☐ Do not switch the connections.
- ☐ Removing and installing. Refer to [⇒ "4.5 Fuel Filter", page 183](#).
- ☐ Installed position: pin on filter housing must engage in recess of guide on filter bracket. Refer to [⇒ Fig. "Installation Position", page 184](#).

2 - Clip

- ☐ For fuel pressure regulator

3 - Fuel Supply Line

- ☐ Black
- ☐ From the fuel tank
- ☐ Press in the circlip to release the lines.

4 - Fuel Return Line

- ☐ Blue
- ☐ To the fuel tank
- ☐ Press in the circlip to release the lines.

5 - Fuel Pressure Regulator

- ☐ New version integrated in fuel filter
- ☐ 4 bar
- ☐ Checking. Refer to [⇒ "3.2 Fuel Pressure Regulator and Residual Pressure, Checking", page 211](#).

6 - Seal

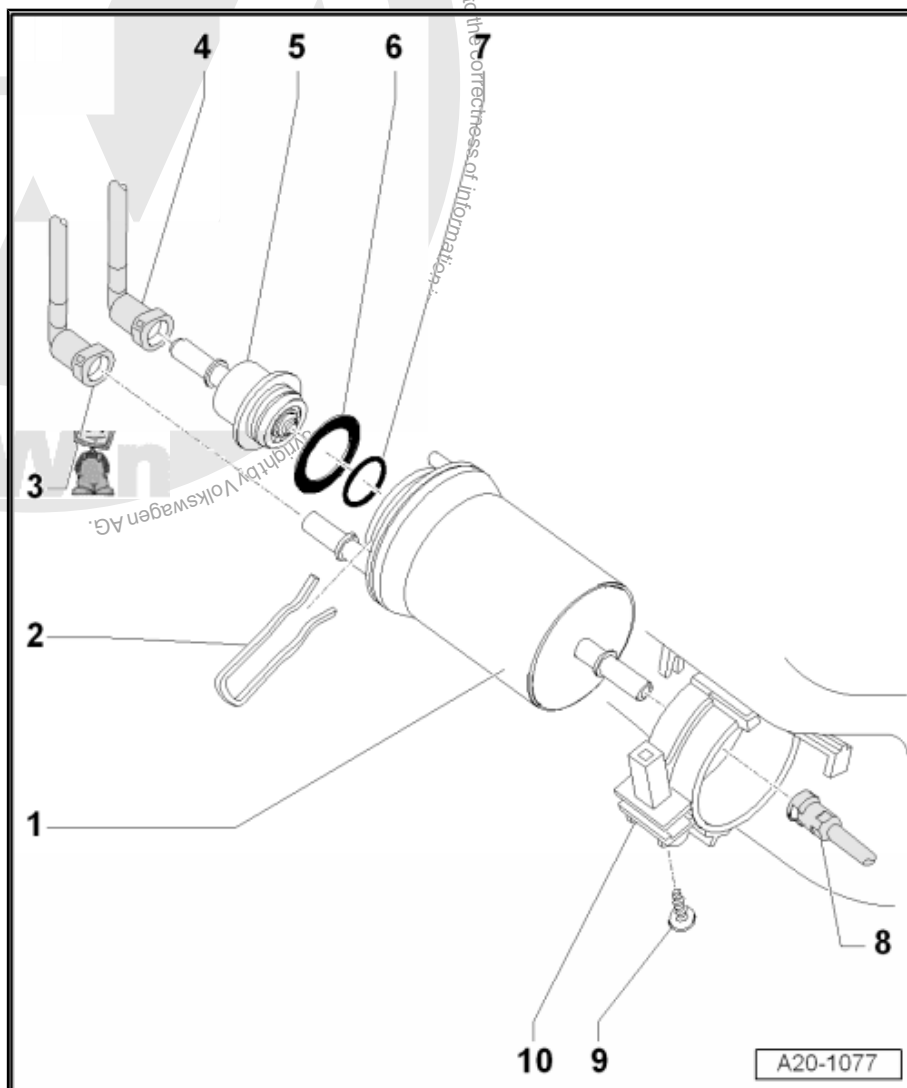
- ☐ Replace

7 - O-Ring

- ☐ Replace

8 - Fuel Supply Line

- ☐ Black
- ☐ To the engine
- ☐ Press in the circlip to release the lines.





9 - Bolt

- ☐ 3 Nm

10 - Mount

- ☐ For fuel filter
- ☐ Secured on the fuel tank.

2.4 Overview - Accelerator Pedal Module

Electronic Power Control (EPC)

1 - Connector

- ☐ Black 6-pin

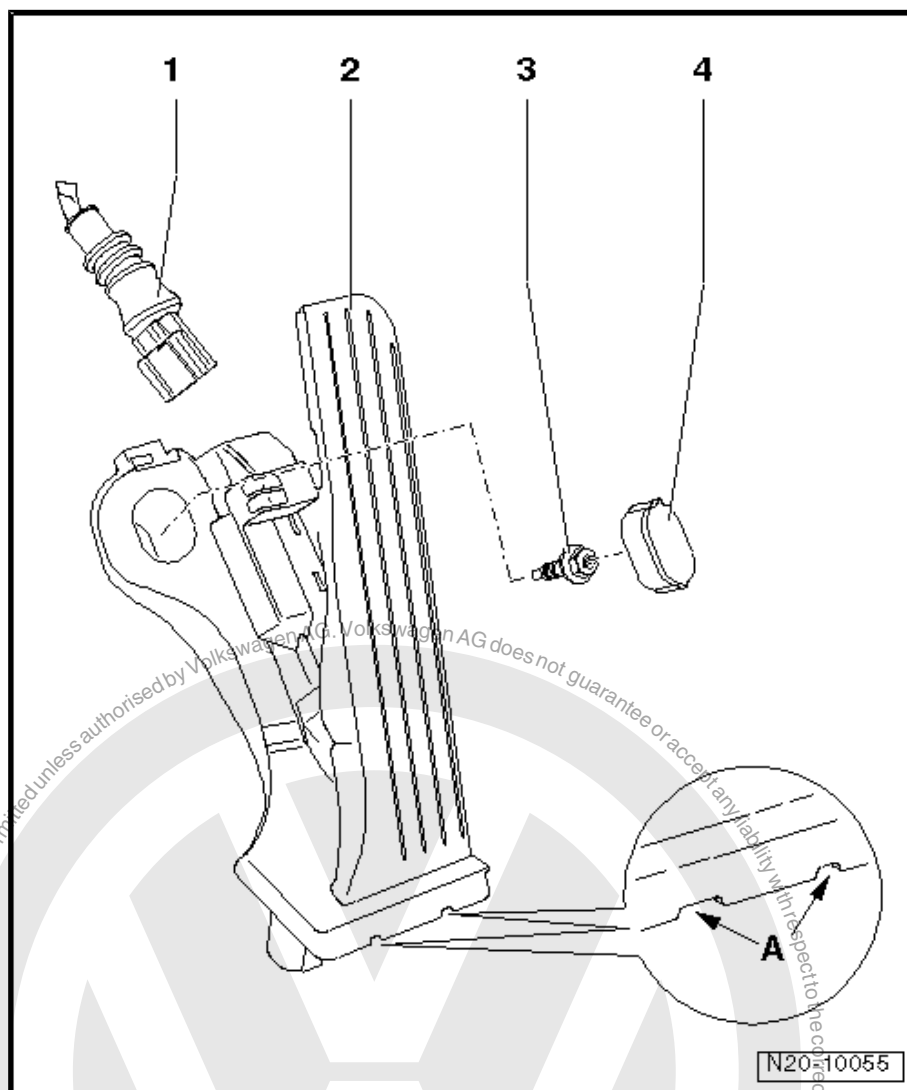
2 - Accelerator Pedal Position Sensor - G79- with Accelerator Pedal Position Sensor 2 - G185-

- ☐ Not adjustable
- ☐ The throttle position sensor transmits the driver control to the engine control module
- ☐ -A- Openings for Accelerator Pedal Module Release Tool - T10238-
- ☐ Removing and installing. Refer to [⇒ "4.7 Accelerator Pedal Module", page 186](#) .

3 - Bolt

- ☐ 10 Nm

4 - Cap





2.5 Overview - EVAP System

⇒ ["2.5.1 Overview - EVAP System", page 149](#)

⇒ ["2.5.2 EVAP System Diagram, through MY 2009", page 151](#)

⇒ ["2.5.3 EVAP System Diagram, from MY 2010", page 152](#)

2.5.1 Overview - EVAP System

1 - Fuel Tank

2 - Breather Line

- ☐ Behind the wheel housing liner

3 - Breather Line

- ☐ On vehicle floor

4 - Breather Line

- ☐ To the EVAP Canister Purge Regulator Valve 1 - N80- on the intake manifold
- ☐ To remove, press release button

5 - Bolt

- ☐ 8 Nm

6 - EVAP Canister

- ☐ Engine Codes BGQ and CBUA
- ☐ Installed location: in the bottom of the spare wheel well
- ☐ Removing and installing. Refer to ["4.8 EVAP Canister", page 189](#).

7 - EVAP Canister

- ☐ Engine code BGP and CBTA
- ☐ Installed location: in the bottom of the spare wheel well
- ☐ Removing and installing. Refer to ["4.8 EVAP Canister", page 189](#).

8 - Connecting Pipe

- ☐ Pressure side
- ☐ On vehicle floor

9 - Connecting Pipe

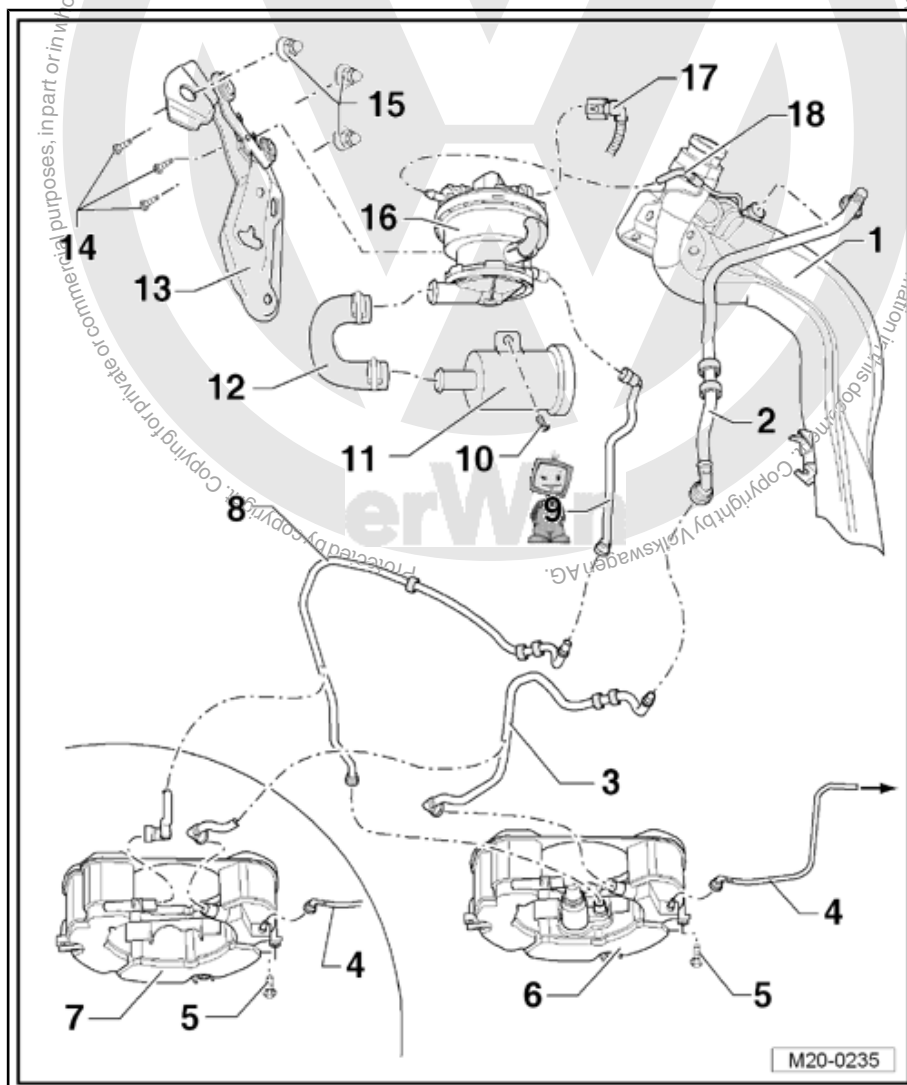
- ☐ Pressure side
- ☐ Behind the wheel housing liner

10 - Bolt

- ☐ 3 Nm

11 - Air Filter

- ☐ for the Leak Detection Pump - V144-





12 - Connecting Hose

- ☐ Intake side

13 - Mount

- ☐ For the Leak Detection Pump - V144-
- ☐ Attached to the right rear wheel housing liner

14 - Bolt

- ☐ 2 Nm

15 - Bolt

- ☐ 9 Nm

16 - Leak Detection Pump - V144-

- ☐ Component location: under the wheel housing liner inside right rear wheel housing
- ☐ Removing and installing. Refer to ⇒ ["4.9. Leak Detection Pump V144 ", page 190](#) .

17 - Connector

- ☐ Black, 3-pin

18 - Vacuum Line

- ◆ Vehicles through MY 2009: from the intake manifold
- ◆ Vehicles from MY 10: from the connection to the vacuum line between the vacuum pump and the brake booster



2.5.2 EVAP System Diagram, through MY 2009

1 - Leak Detection Pump - V144-

- ☐ Component location: under the wheel housing liner inside the right rear wheel housing
- ☐ Checking Vehicle Diagnostic Tester .
- ☐ Removing and installing. Refer to ⇒ ["4.9 Leak Detection Pump V144"](#), page 190 .

2 - Connecting Line

- ☐ From the Leak Detection Pump - V144- to the EVAP canister.
- ☐ On the EVAP canister

3 - EVAP Canister

- ☐ Installed location: in the bottom of the spare wheel well
- ☐ Removing and installing. Refer to ⇒ ["4.8 EVAP Canister"](#), page 189 .

4 - Separating Point

- ☐ On the back of the fuel tank, on the right side

5 - Throttle Valve Control Module - J338-

Removing and installing. Refer to ⇒ ["4.2 Throttle Valve Control Module J338"](#), page 216 .

6 - EVAP Canister Purge Regulator Valve 1 - N80-

- ☐ Checking Vehicle Diagnostic Tester .

7 - Vacuum Line

- ☐ Connected to the intake manifold

8 - Separating Point

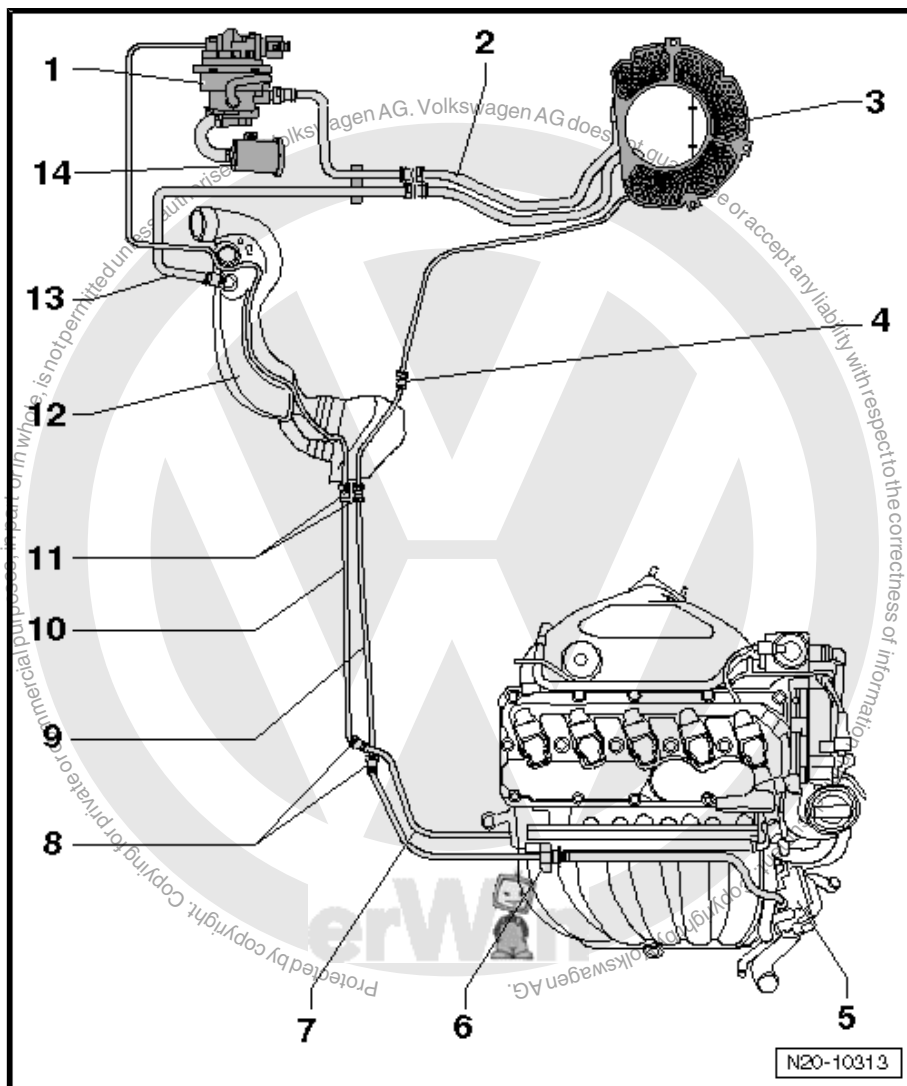
- ☐ In the front of the engine compartment on the right side, under the coolant reservoir

9 - Breather Line

- ☐ White
- ☐ From EVAP canister to EVAP Canister Purge Regulator Valve 1 - N80-
- ☐ Installed position: on the right side the underbody
- ☐ Secured on the fuel tank.

10 - Vacuum Line

- ☐ Green
- ☐ From the engine to the Leak Detection Pump - V144- .
- ☐ Installed position: on the right side the underbody
- ☐ Secured on the fuel tank.





11 - Separating Point

- ☐ In front of the fuel tank on the right side, near the fuel filter

12 - Filler Neck

13 - Breather Line

- ☐ From the filler tube to the EVAP canister

14 - Air Filter

- ☐ For the Leak Detection Pump - V144-

2.5.3 EVAP System Diagram, from MY 2010

1 - Leak Detection Pump - V144-

- ☐ Component location: under the wheel housing liner inside right rear wheel housing
- ☐ Checking Vehicle Diagnostic Tester .
- ☐ Removing and installing. Refer to ➔ ["4.9 Leak Detection Pump V144"](#), page 190 .

2 - Connecting Line

- ☐ From the Leak Detection Pump - V144- to the EVAP canister.
- ☐ On the EVAP canister

3 - EVAP Canister

- ☐ Installed location: in the bottom of the spare wheel well
- ☐ Removing and installing. Refer to ➔ ["4.8 EVAP Canister"](#), page 189 .

4 - Separating Point

- ☐ On the back of the fuel tank, on the right side

5 - Vacuum Line

- ☐ Connection to the vacuum line between the vacuum pump and the brake booster item 7- ➔ [Item 7 \(page 152\)](#)
- ☐ Attached to the bulkhead by 3 clips

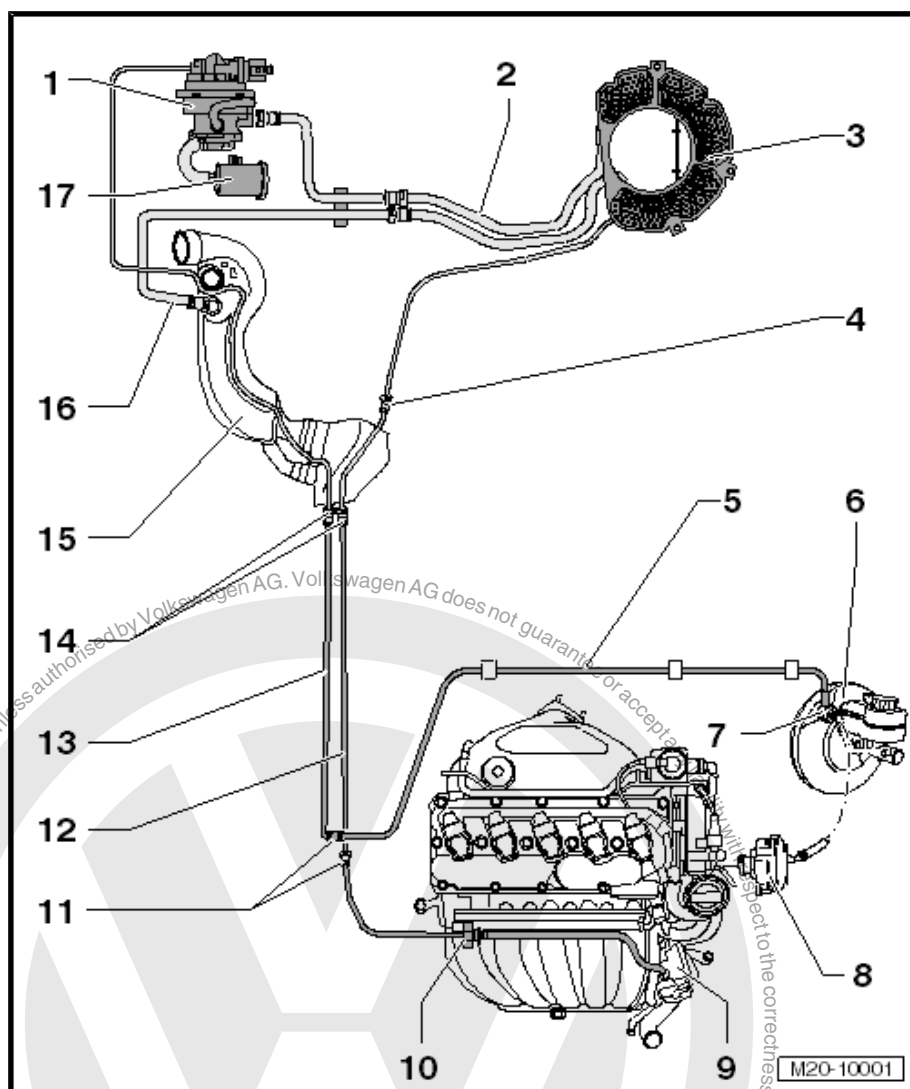
6 - Brake Booster

7 - Vacuum Line, from Vacuum Pump to Brake Booster

8 - Vacuum Pump

9 - Throttle Valve Control Module - J338-

Removing and installing ➔ ["4.2 Throttle Valve Control Module J338"](#), page 216





10 - EVAP Canister Purge Regulator Valve 1 - N80-

- ☐ Checking Vehicle Diagnostic Tester .

11 - Separating Point

- ☐ In the front of the engine compartment on the right side, under the coolant reservoir

12 - Breather Line

- ☐ White
- ☐ from EVAP canister to EVAP Canister Purge Regulator Valve 1 - N80-
- ☐ Installed position: on the right side the underbody
- ☐ Secured on the fuel tank.

13 - Vacuum Line

- ☐ Green
- ☐ From the engine to the Leak Detection Pump - V144- .
- ☐ Installed position: on the right side the underbody
- ☐ Secured on the fuel tank.

14 - Separating Point

- ☐ In front of the fuel tank on the right side, near the fuel filter

15 - Filler Neck

16 - Breather Line

- ☐ From the filler tube to the EVAP canister

17 - Air Filter

- ☐ For the Leak Detection Pump - V144-

2.6 Overview - EVAP System

⇒ **"2.6.1 Overview - EVAP System", page 153**

2.6.1 Overview - EVAP System



Note

- ◆ *Hose connections are secured with either spring-type or clamp-type clips.*
- ◆ *Always replace clamp-type clips with spring-type clips.*
- ◆ *Use Spring-Type Clip Pliers to installing spring clips.*



1 - EVAP Canister

- ❑ Installed location: inside the engine compartment on the right side

2 - Pressure Retaining Valve with Connecting Hose

3 - Breather Line

- ❑ Make sure it is secure
- ❑ From the fuel tank

4 - Bolt

- ❑ 10 Nm

5 - EVAP Canister Purge Regulator Valve 1 - N80-

- ❑ The valve is closed when the ignition is off
- ❑ Valve is activated (pulsed) by the engine control module when the engine is warm

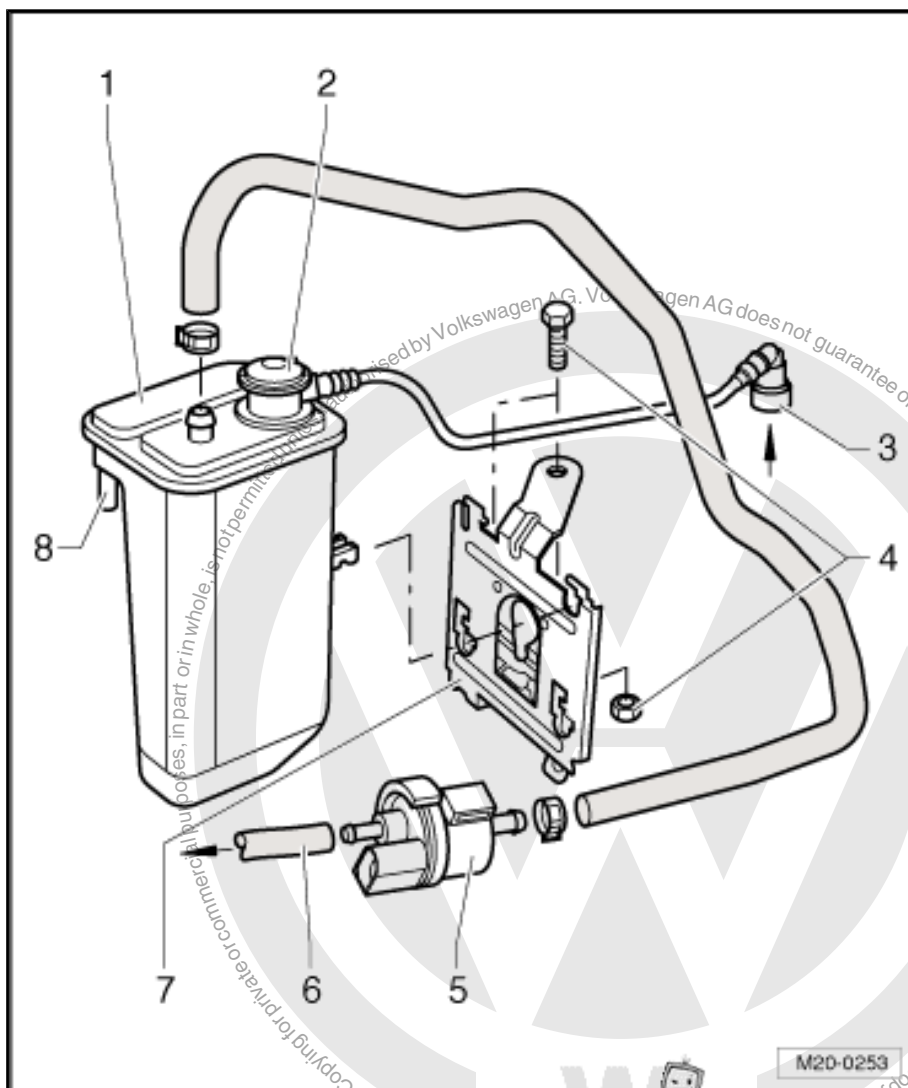
6 - Connecting Hose

- ❑ To the intake manifold
- ❑ Make sure it is secure

7 - Mount

- ❑ For the EVAP canister
- ❑ New version. Refer to [Fig. "EVAP canister bracket - new version"](#), page 154

8 - Breather Connection



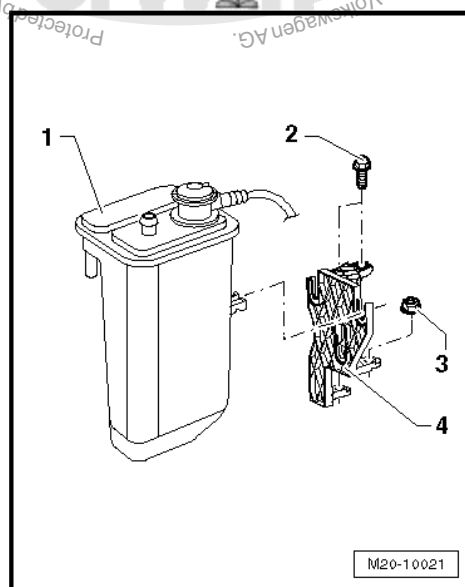
EVAP canister bracket - new version

1 - EVAP Canister

2 - Bolt, 10 Nm

3 - Nut, 10 Nm

4 - Bracket, new version made of plastic





3 Diagnosis and Testing

⇒ [“3.1 Fuel Pump, Checking”, page 155](#)

⇒ [“3.2 Fuel System, Checking for Leaks”, page 163](#)

BTK and CCCA

⇒ [“3.3 Fuel Tank, Checking Ventilation”, page 170](#)

3.1 Fuel Pump, Checking

⇒ [“3.1.1 Function and Power Supply, Checking”, page 155](#)

⇒ [“3.1.2 Delivery Quantity, Checking”, page 156](#)

⇒ [“3.1.3 Current Draw, Checking”, page 160](#)

⇒ [“3.1.4 Fuel Pump Check Valve, Checking”, page 161](#)

3.1.1 Function and Power Supply, Checking

Special tools and workshop equipment required

- ◆ Pressure Tester Kit - VAS6550-
- ◆ Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A-
- ◆ Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565-
- ◆ Analog/Digital Multimeter - FLU83III-
- ◆ Wrench - Fuel Sending Unit - T10202-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Voltage Tester - VAS6839-
- ◆ Diagnostic Tester
- ◆ Measuring container, three liter
- Battery voltage at least 11.5 V
- Fuel pump fuse on the fuse panel OK. Refer to ⇒ Wiring diagrams, Troubleshooting & Component locations.



Note

The output diagnostic test mode checks the fuel pump.

- Connect the Vehicle Diagnostic Tester as follows:
- Connect the diagnostic cable connector to the diagnostic connection inside the driver footwell.
- Switch the ignition on.
- Press buttons for “Vehicle Self-Diagnosis”, “01 - Engine electronics” and “Output Diagnostic Test Mode (DTM)” on display in succession.
- Press right arrow button on display to initiate fuel pump activation.

The fuel pump must now run.



Note

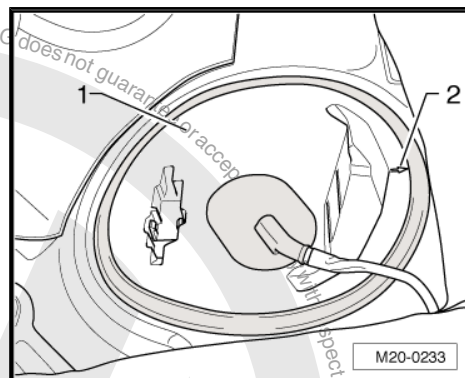
The fuel pump runs very quietly.



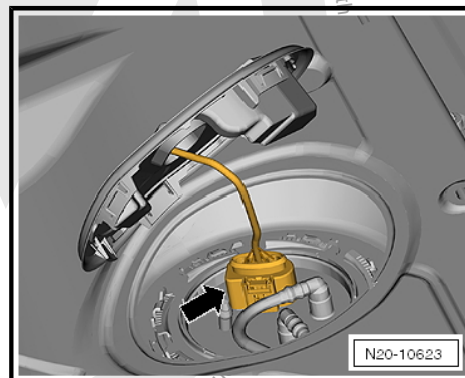
- Turn off the ignition.

If the fuel pump does not start

- Remove the bench seat. Refer to ➔ Body Interior; Rep. Gr. 72 ; Rear Seats; Bench Seat, Removing and Installing .
- Unclip the cover -1- from the fuel delivery unit. The arrow -2- points in direction of travel.



- Pull on the connector -arrow- without pressing the retainer to make sure it is connected securely. If the connector was not connected correctly, check the fuel pump function again.
- Disconnect the connector.
- Check the contacts on the connector and the fuel delivery unit for damage.

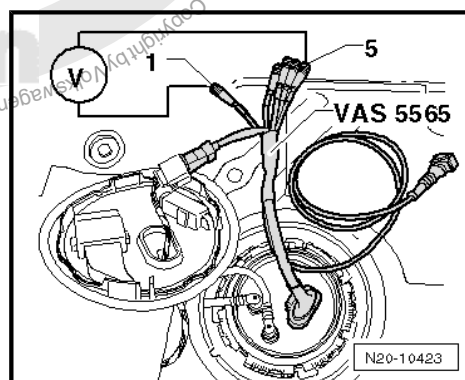


- Attach the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- to the connecting piece and to the fuel delivery unit.
- Connect the Voltage Tester - VAS6839- to the wires -1- and -5- for the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- .

- Switch the ignition on.
- LED must light up briefly.

If LED does not light up briefly:

- Locate and repair open circuit in wiring according to the wiring diagram. Refer to ➔ Wiring diagrams, Troubleshooting & Component locations.



LED lights up briefly (voltage supply OK):

- Remove fuel delivery unit. Refer to ➔ ["4.2 Fuel Delivery Unit", page 177](#) .
- Check if the electrical wiring between the flange and fuel pump is connected.

If no open circuits are found:

- Fuel Pump (FP) faulty, replace fuel delivery unit. Refer to ➔ ["4.2 Fuel Delivery Unit", page 177](#) .

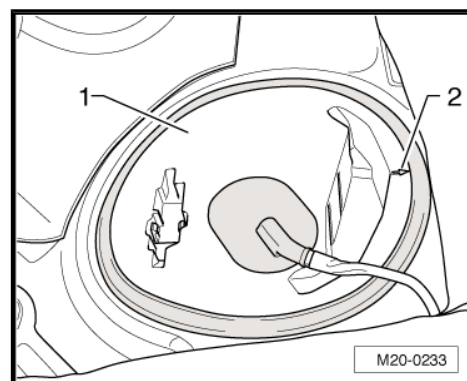
3.1.2 Delivery Quantity, Checking

Special tools and workshop equipment required

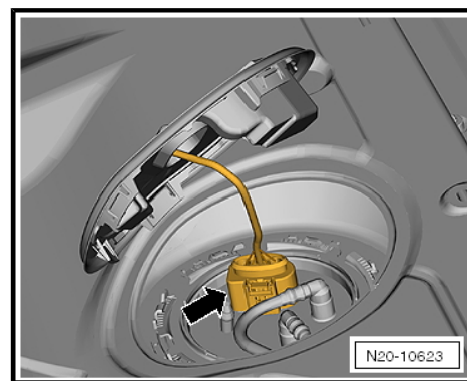
- ♦ Pressure Tester Kit - VAS6550-



- ◆ Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A-
 - ◆ Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565-
 - ◆ Analog/Digital Multimeter - FLU83III-
 - ◆ Wrench - Fuel Sending Unit - T10202-
 - ◆ Torque Wrench 1332 40-200Nm - VAG1332-
 - ◆ Voltage Tester - VAS6839-
 - ◆ Diagnostic Tester
 - ◆ Measuring container, three liter
 - Voltage supply OK.
 - The fuel pressure regulator and the residual pressure are OK.
 Refer to
 ⇒ ["3.2 Fuel Pressure Regulator and Residual Pressure, Checking", page 211](#) .
 - The fuel filter is OK.
- Remove the fuel cap from the fuel filler tube.
- Remove the bench seat. Refer to ⇒ Body Interior; Rep. Gr. 12 ; Rear Seats; Bench Seat, Removing and Installing .
 - Unclip the cover -1- from the fuel delivery unit. The arrow -2- points in direction of travel.



- Pull on the connector -arrow- without pressing the retainer to make sure it is connected securely. If the connector was not connected correctly, it could cause a fault.
- Disconnect the connector.
- Check the contacts on the connector and the fuel delivery unit for damage.





- Attach the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- to the connecting piece and to the fuel delivery unit.
- Connect the Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A- to the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- and battery positive (+).



Note

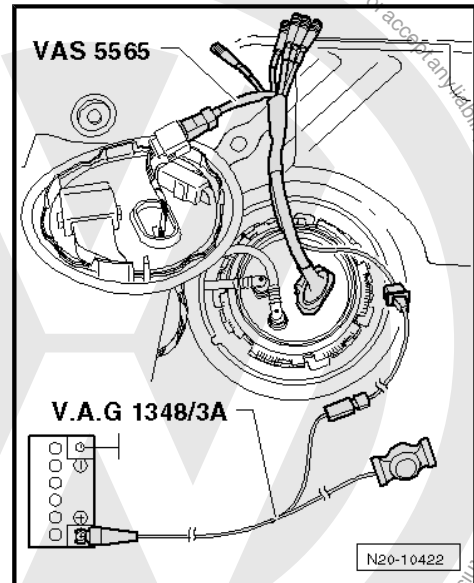
- ◆ This work step allows the fuel pump to run when the engine is not running.
- ◆ The fuel pump delivery quantity is measured at 4 bar. Therefore, measure the fuel pressure before measuring the delivery rate. Refer to
⇒ "3.2 Fuel Pressure Regulator and Residual Pressure, Checking", page 211.



WARNING

Fuel system is under pressure!

- ◆ Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.
- ◆ Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.



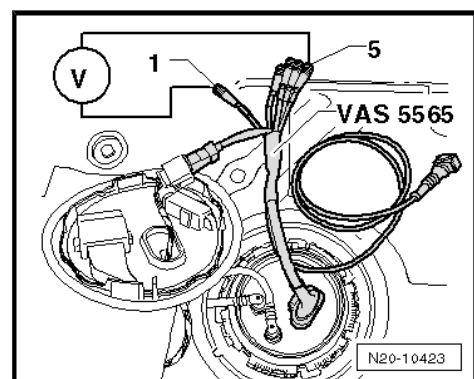
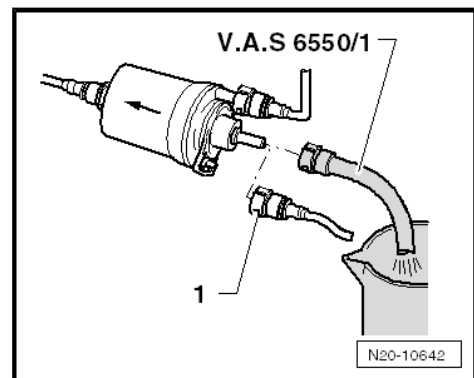
- Disconnect the return line -1- from the fuel pressure regulator.



Note

Press in securing ring to disengage the fuel line.

- Connect the Pressure Tester Kit - Hose 1 - VAS6550/1- to the fuel pressure regulator and hold the end of adapter in a measuring container.
- Operate the Injection Rate Comparison Meter Kit - Remote Cable -VAG1348/3A- for approximately 5 seconds in order to fill the fuel filter.
- Empty the measuring container.
- The fuel pump delivery rate depends on the voltage. Therefore, also connect the Analog/Digital Multimeter - FLU83III- to connectors -1 and 5- on the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- .
- Operate the remote control for 60 seconds and simultaneously measure voltage on the fuel pump.





- Compare the quantity of fuel delivered with specification.

*) Minimum delivery rate $\text{cm}^3/60 \text{ s}$

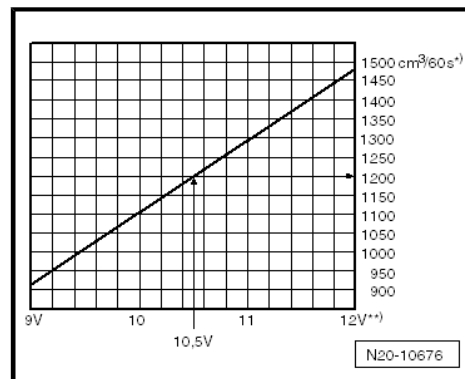
***) Voltage on the fuel pump with engine running in idle and the pump is on.

Example:

During test, a voltage of 10.5 Volts is measured. This results in a minimum delivery quantity of approximately $1200 \text{ cm}^3/60 \text{ s}$.

If the minimum delivery rate is not attained:

- Check the fuel filter as follows:

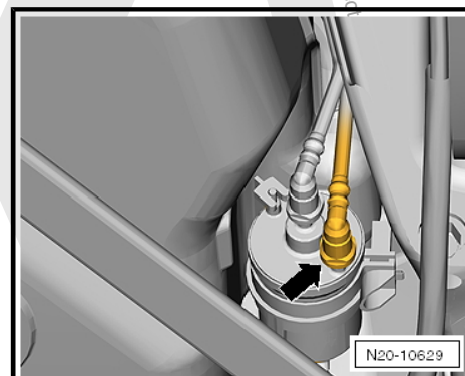


WARNING

Fuel system is under pressure!

- ◆ ***Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.***
- ◆ ***Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.***

- Disconnect the fuel supply line -arrow- from the fuel filter.





- Connect the Diesel Pressure Tester Kit - VAS6550- with the Pressure Tester Kit - Hose 1 - VAS6550/1- to the fuel supply line. Hold the Pressure Tester Kit - Hose 2 - VAS6550/2- into a measuring container.
- Make sure the drain is closed and the shut-off valves are open.
- Operate the Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A- . Slowly close the shut-off valve -A- until the pressure gauge reads 4 bar. From this point on do not move position of shut-off valve.
- Empty measuring container.
- Repeat the fuel delivery test.

If the minimum delivery rate is now obtained:

- Replace fuel filter.

If minimum delivery rate is again not obtained:

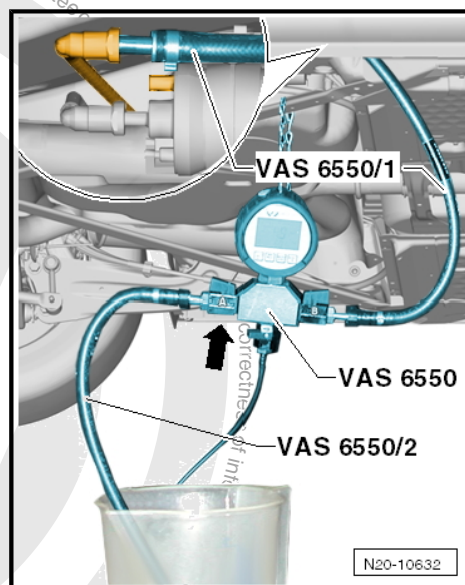
- Remove the fuel delivery unit and check fuel strainer for soiling.

Only when up to now no malfunction has been detected:

- Replace the fuel delivery unit. Refer to [⇒ "4.2 Fuel Delivery Unit", page 177](#) .
- Connect all disconnected fuel lines.
- Bleed the fuel system. Refer to [⇒ "4.6 Fuel System, Bleeding", page 184](#) .

Delivery rate has been obtained, but malfunctions are still suspected in the fuel supply, for example sporadic loss of fuel supply:

- Check the fuel pump current draw. Refer to [⇒ "3.1.3 Current Draw, Checking", page 160](#) .



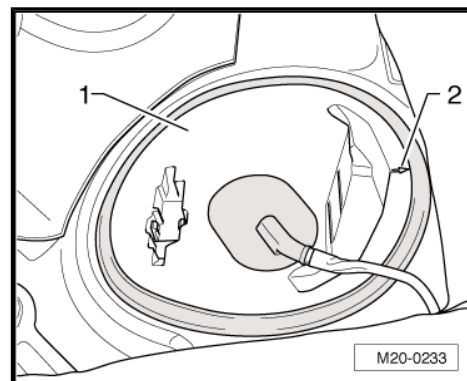
3.1.3 Current Draw, Checking

Special tools and workshop equipment required

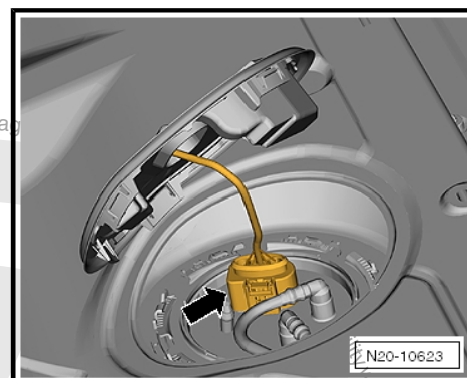
- ◆ Pressure Tester Kit - VAS6550-
- ◆ Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A-
- ◆ Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565-
- ◆ Analog/Digital Multimeter - FLU83III-
- ◆ Wrench - Fuel Sending Unit - T10202-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Voltage Tester - VAS6839-
- ◆ Diagnostic Tester
- ◆ Measuring container, three liter
- Remove the bench seat. Refer to [⇒ Body Interior; Rep. Gr. 72 ; Rear Seats; Bench Seat, Removing and Installing](#) .



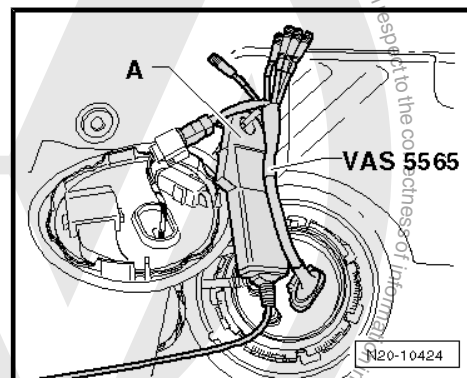
- Unclip the cover -1- from the fuel delivery unit. The arrow -2- points in direction of travel.



- Pull on the connector -arrow- without pressing the retainer to make sure it is connected securely. If the connector was not connected correctly, it could cause a fault.
- Disconnect the connector.
- Check the contacts on the connector and the fuel delivery unit for damage.



- Attach the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- to the connecting piece and to the fuel delivery unit.
- Connect the current probe -A- to the red wire with the word "current probe" on the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- .
- Start the engine and run at idle speed.
- Measure current draw of fuel pump.
 Specified value: maximum 9 amps



Note

If malfunction in fuel system is sporadic, test can also be performed during a road test, but a second person is required.

If the current draw is exceeded:

- Fuel Pump (FP) faulty, replace fuel delivery unit. Refer to [⇒ "4.2 Fuel Delivery Unit", page 177](#) .

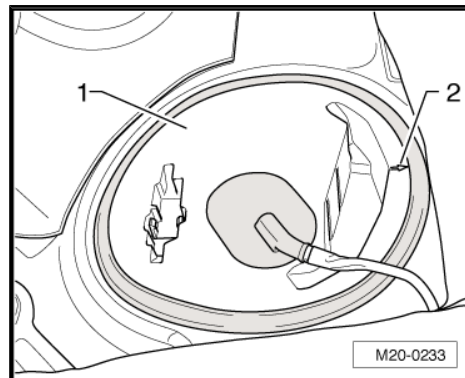
3.1.4 Fuel Pump Check Valve, Checking

Special tools and workshop equipment required

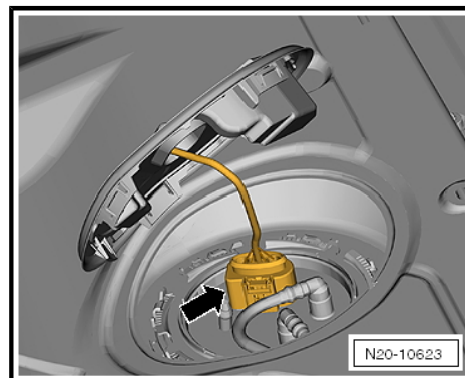
- ◆ Pressure Tester Kit - VAS6550-
- ◆ Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A-
- ◆ Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565-
- ◆ Analog/Digital Multimeter - FLU83III-
- ◆ Wrench - Fuel Sending Unit - T10202-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Voltage Tester - VAS6839-



- ◆ Diagnostic Tester
- ◆ Measuring container, three liter
- Remove the bench seat. Refer to ➔ Body Interior; Rep. Gr. 72 ; Rear Seats; Bench Seat, Removing and Installing .
- Unclip the cover -1- from the fuel delivery unit. The arrow -2- points in direction of travel.



- Pull on the connector -arrow- without pressing the retainer to make sure it is connected securely. If the connector was not connected correctly, it could cause a fault.
- Disconnect the connector.
- Check the contacts on the connector and the fuel delivery unit for damage.



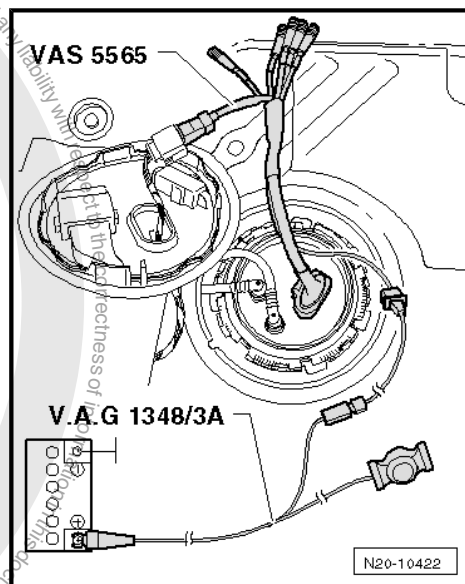
- Attach the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- to the connecting piece and to the fuel delivery unit.
- Connect the Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A- to the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- and battery positive (+).



WARNING

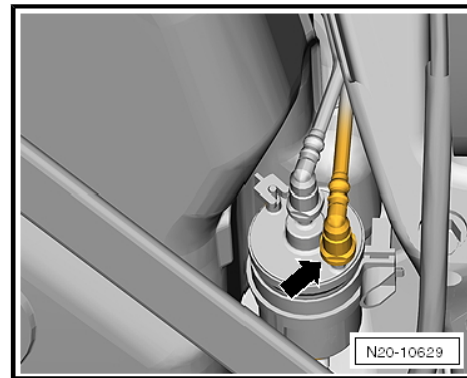
Fuel system is under pressure!

- ◆ Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.
- ◆ Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.





- Disconnect the fuel supply line -arrow- from the fuel filter.

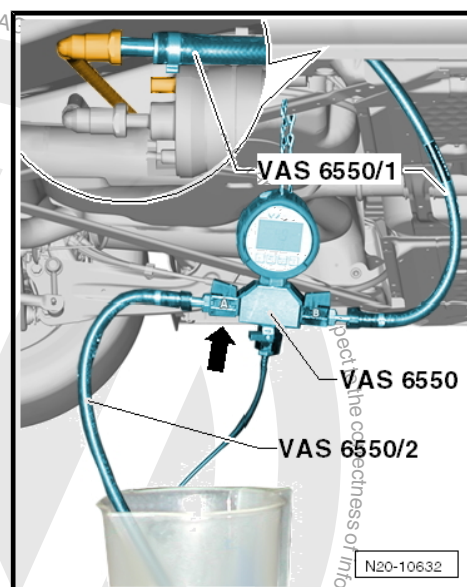


- Connect the Diesel Pressure Tester Kit - VAS6550- with the Pressure Tester Kit - Hose 1 - VAS6550/1- to the fuel supply line. Hold the Pressure Tester Kit - Hose 2 - VAS6550/2- into a measuring container.
- Close the shut-off valve -A- on the Pressure Tester Kit - VAS6550- (the lever is perpendicular to the flow direction).
- Operate the remote cable at short intervals until a pressure of approximately 4 bar has built up.



WARNING

Danger of spraying when opening shut-off valve; wear protective goggles and protective clothing to prevent injuries and contact with skin. Hold container in front of free connection of pressure measuring device.



- If pressure builds up too high, lower excess pressure by carefully opening the shut off valve.
- Watch the pressure decrease on the pressure gauge.
- The pressure must not drop below 3 bar after 10 minutes.

If the pressure drops further:

- Check the line connections for leaks.

If no fault is detected in the wiring:

- Fuel Pump (FP) faulty, replace fuel delivery unit. Refer to [⇒ "4.2 Fuel Delivery Unit", page 177](#).

3.2 Fuel System, Checking for Leaks

⇒ ["3.2.1 Checking for Leaks", page 163](#)

⇒ ["3.2.2 Large Leak Test in Fuel System", page 168](#)

⇒ ["3.2.3 Overview - EVAP System, Function", page 168](#)

⇒ ["3.2.4 Leak Detection Pump V144, Checking Vacuum Supply", page 169](#)

3.2.1 Checking for Leaks

Special tools and workshop equipment required

- ◆ Evaporative Emissions Tester - KLI9210-
- ◆ Evaporative Emissions Tester - Adapter 55 - KLI9210/55-1-
- ◆ Vehicle Diagnostic Tester
- ◆ Hose Clamps - Up To 25 mm - 3094-



Test conditions:

- Guided Fault Finding was performed using the Vehicle Diagnostic Tester .
- The Leak Detection Pump - V144- detected a leak.

Evaporative Emissions Tester - KLI9210- preparation:



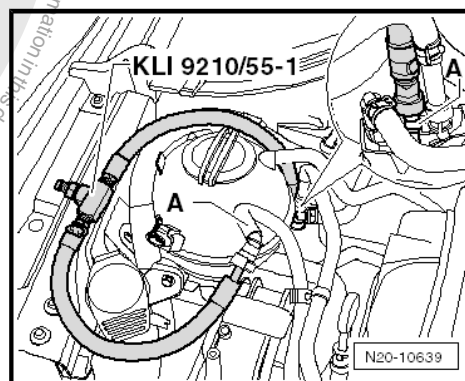
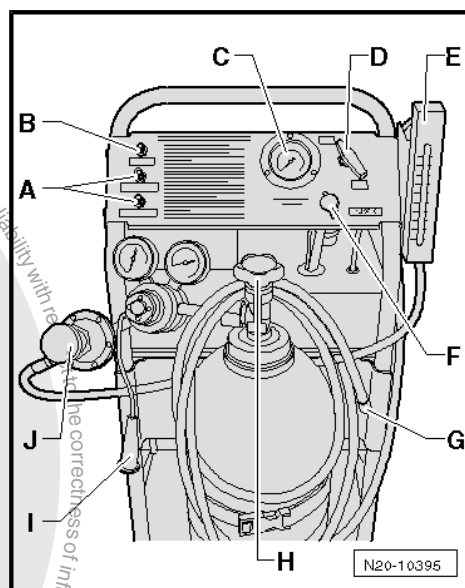
Note

Depending on the version, the appearance of the Evaporative Emissions Tester - KLI9210- may vary.

- Check on Evaporative Emissions Tester - KLI9210- whether there is enough fluid in the smoke generator.
- Set valve -D- to “Hold”.
- Open nitrogen bottle -H-.
- Connect the measuring hose -G- on self-test connection -B-.
- Set valve -D- to “Test”.
- Using the pressure reducer -J-, adjust the pressure to 10 in. H₂O (25 mbar).
- Set valve -D- to “Hold”.
- The pressure must now be maintained min. 2 minutes. If the pressure is not maintained, check the tester.

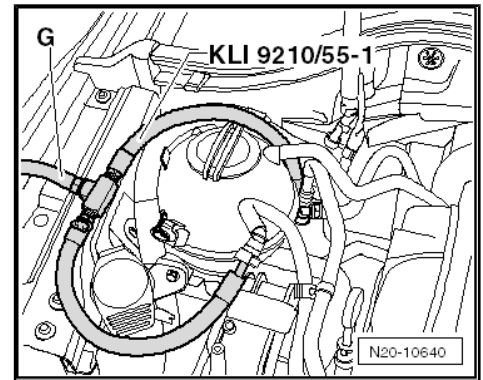
Fuel system, checking for leaks:

- Connect the Evaporative Emissions Tester - Adapter 55-1 - KLI9210/55-1- to the breather lines -A- as illustrated.





- Connect the measuring hose -G- from the Evaporative Emissions Tester - KLI9210- to the Evaporative Emissions Tester - Adapter 55-1 - KLI9210/55-1 .
- Connect evaporative emissions tester to vehicle.
- Start engine and run at idle speed.
- Select **Guided Functions**
- Select “Check tank ventilation system for leaks” guided function.
- Start the test.
- Watch the pressure gauge on the Evaporative Emissions Tester - KLI9210- during the test.
- The Leak Detection Pump - V144- must pump the fuel system pressure up to at least 18 mbar (7 in. H₂O).



The minimum pressure is not reached, but the pressure reached does not decrease:

- Turn off the ignition.
- Check the vacuum supply to the Leak Detection Pump - V144- . Refer to
⇒ [“3.2.4 Leak Detection Pump V144 , Checking Vacuum Supply”, page 169](#) .

The minimum pressure is not reached and the pressure reached decreases immediately:

Large leak in the fuel system.

- Turn off the ignition.
- Perform a “fuel system leak test”. Refer to
⇒ [“3.2.2 Large Leak Test in Fuel System”, page 168](#) .

The minimum pressure is not reached:

- Turn off the ignition.



Note

The valve in the Leak Detection Pump - V144- is now closed and the pressure is maintained.

- Set valve -D- to “Test”. Increase the pressure present up to 25 mbar (10 in. H₂O).
- Observe the pressure gauge -C- and flow meter -E-. If the flow quantity decreases and pressure increases to 25 mbar (10 in. H₂O), fuel system is filled.

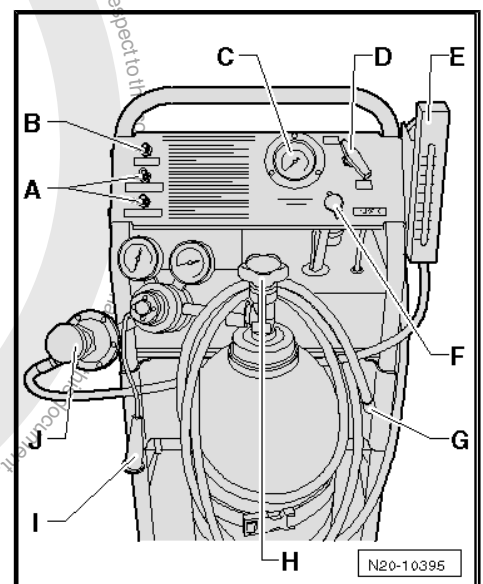


Note

Depending on the level in the fuel tank, this procedure may take up to 3 minutes.

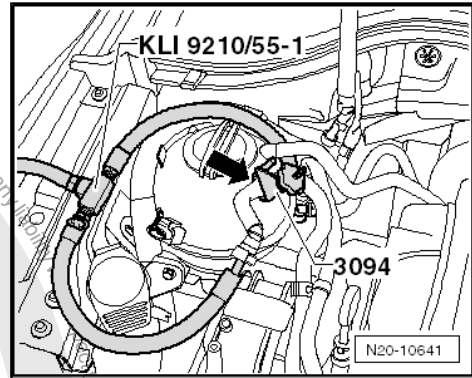
- After the pressure has stabilized, set valve -D- to “Hold”.
- After 5 minutes the pressure must not drop below 20 mbar (8 in. H₂O).

If the pressure is not maintained for 5 minutes, the leak should be localized as follows:





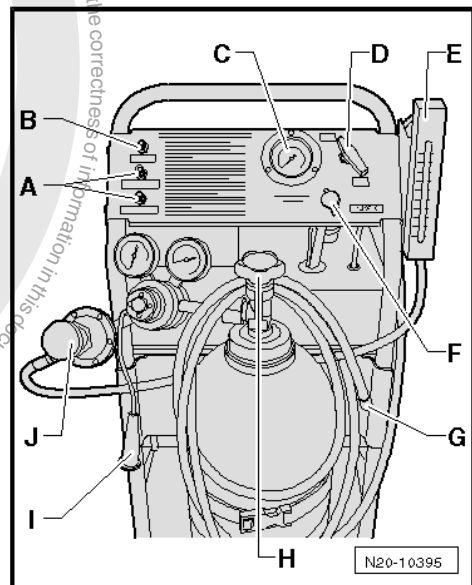
- First check the EVAP Canister Purge Regulator Valve 1 - N80- for leaks. To do this, clamp off the hose to the EVAP Canister Purge Regulator Valve 1 - N80- with a hose clamp -arrow-.



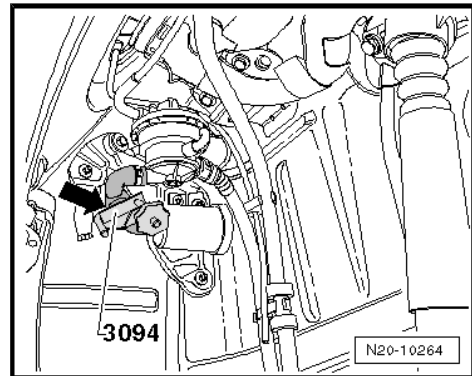
- Repeat pressure test by resetting valve -D- to "Test".
- Observe pressure gauge and flow meter. If the flow quantity decreases and pressure increases to 25 mbar (10 in. H₂O), fuel system is filled.
- After the pressure has stabilized, set valve -D- to "Hold".
- If the pressure now stops decreasing, replace the EVAP Canister Purge Regulator Valve 1 - N80- .

If pressure still drops:

- Remove the right rear wheel housing liner.



- Clamp off the hose between the Leak Detection Pump - V144- item 8- ➔ [Item 8 \(page 169\)](#) and air filter -arrow- -item 7- ➔ [Item 7 \(page 169\)](#) .





- Set the valve -D- to “Test”.
- Observe the pressure gauge -C- and flow meter -E-. If the flow quantity decreases and pressure increases to 25 mbar (10 in. H₂O), fuel system is filled.



Note

Depending on the level in the fuel tank, this procedure may take up to 3 minutes.

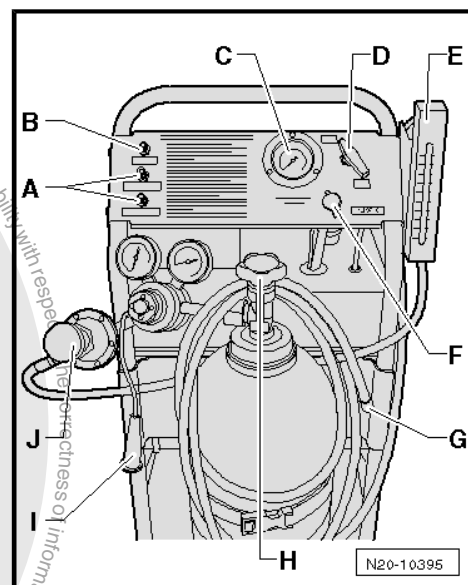
- After the pressure has stabilized, set valve -D- to “Hold”.
- After 5 minutes the pressure must not drop below 20 mbar (8 in. H₂O).
- If the pressure no longer decreases, replace the Leak Detection Pump - V144- .

If pressure still drops:

- Set the valve -D- to “Test”.
- While fuel system is being filled, press smoke generator button -I- for approximately one minute.

The fuel system is now under pressure and filled with smoke.

- Check all fuel system lines and hoses for escaping smoke. Also check fuel tank sealing cap.

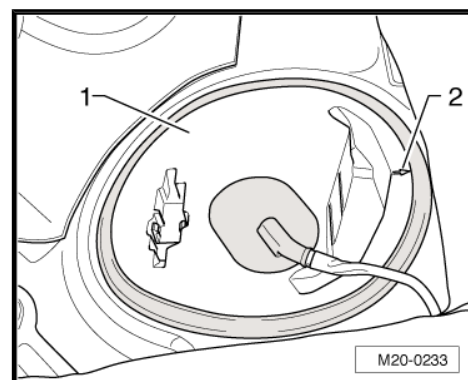


Note

- ◆ *Illuminate components and hoses with a strong flood light, the smoke will be more visible.*
- ◆ *To check for leaks at accessible locations, also use ultrasonic measuring device or commercially available leak detection spray.*
- ◆ *Depending on how long fault finding lasts, the smoke generator button may have to be pressed again. This ensures there is enough smoke present in the fuel system.*
- ◆ *Remove the cover -1- to check the fuel delivery unit flange.*

- Replace leaking hoses or components.

After completing the work, perform “Check tank ventilation system for leaks” guided function using the Vehicle Diagnostic Tester .





3.2.2 Large Leak Test in Fuel System

Test conditions:

- The Evaporative Emissions Tester - KLI9210DLX- is connected to the vehicle with the Evaporative Emissions Tester - Adapter Hose - KLI9210/55-1- . Refer to ➔ [“3.2 Fuel System, Checking for Leaks”, page 163](#) .
- Connect the Evaporative Emissions Tester - KLI9210- to the vehicle battery.
- Remove the right rear wheel housing liner.
- Clamp off the hose between the Leak Detection Pump - V144- -item 8- ➔ [Item 8 \(page 169\)](#) and air filter -arrow- -item 7- ➔ [Item 7 \(page 169\)](#) .
- Set valve -D- to “Test”.
- While fuel system is being filled, press smoke generator button -I- for approximately one minute.

The fuel system is now under pressure and filled with smoke.

- Check all fuel system lines and hoses for escaping smoke. Also check fuel tank sealing cap.

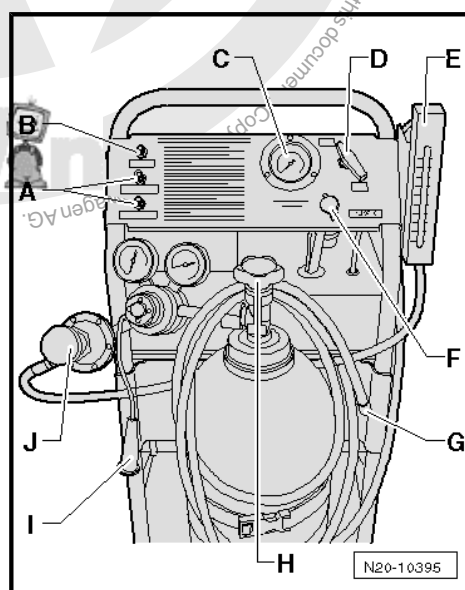
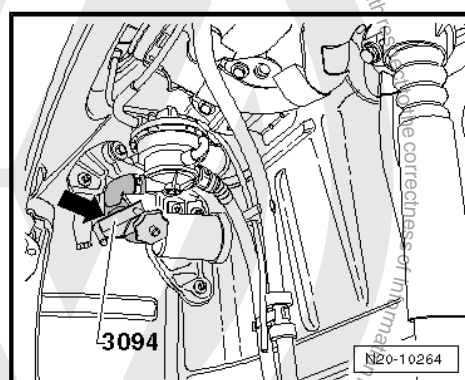
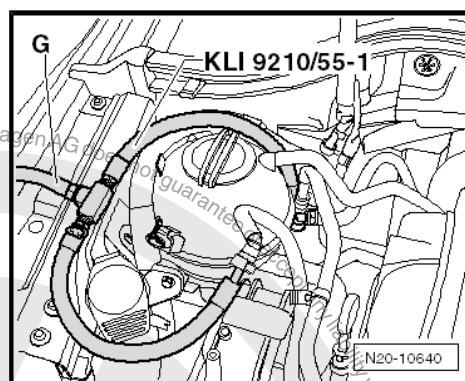


Note

- ◆ *Illuminate components and hoses with a strong flood light, the smoke will be more visible.*
- ◆ *To check for leaks at accessible locations, also use ultrasonic measuring device or commercially available leak detection spray.*
- ◆ *Depending on how long fault finding lasts, the smoke generator button may have to be pressed again. This ensures there is enough smoke present in the fuel system.*
- ◆ *To check fuel pump and fuel filter flange, the assembly openings in the vehicle interior must be opened.*

- Replace leaking hoses or components.

After completing the work, perform “Check tank ventilation system for leaks” guided function using the Vehicle Diagnostic Tester .



3.2.3 Overview - EVAP System, Function



1 - EVAP Canister

2 - Component location for Adapter Hose - KLI9210/55-1-

- ☐ During the leak test in fuel system

3 - EVAP Canister Purge Regulator Valve 1 - N80-

4 - Breather line

- ☐ To the Throttle Valve Control Module - J338-

5 - Solenoid Valve

- ☐ for the Leak Detection Pump - V144-

6 - Vacuum line

- ◆ Vehicles through MY 2009: to the intake manifold
- ◆ Vehicles from MY 2010: to the connection to the vacuum line between the vacuum pump and the brake booster

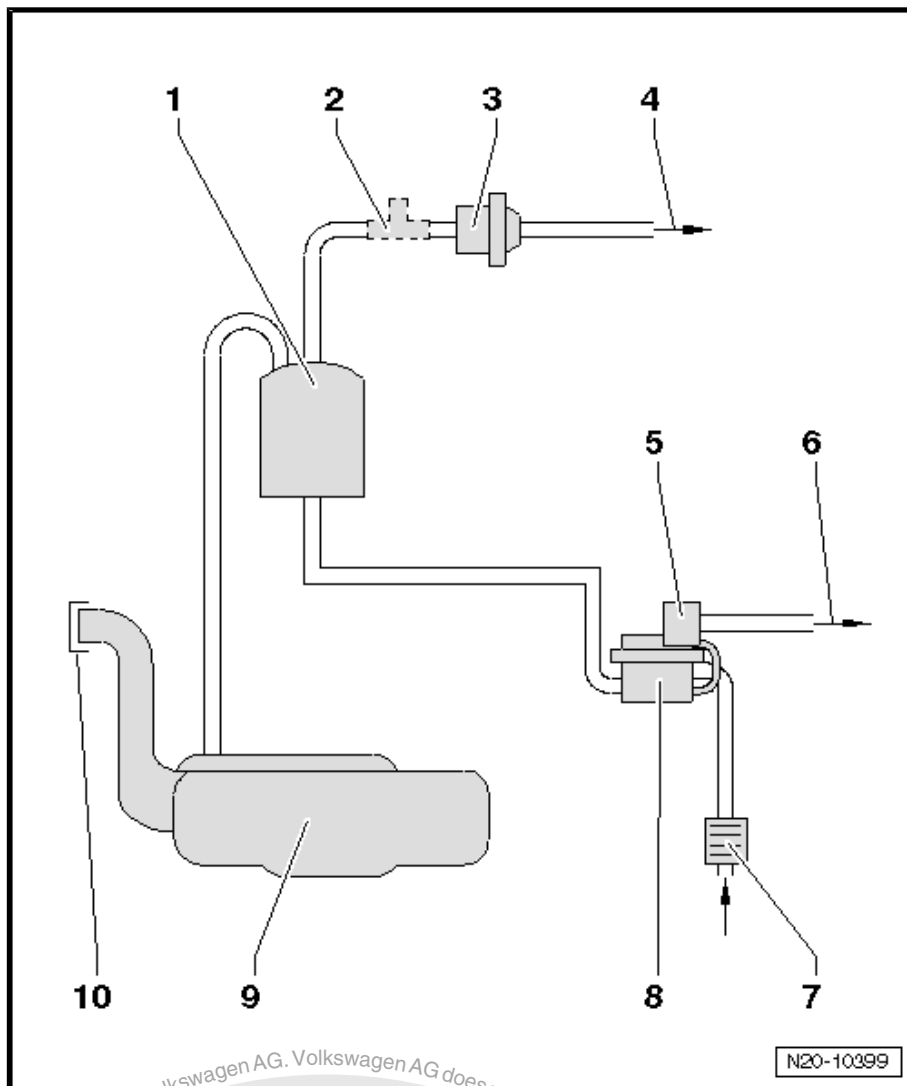
7 - Air Filter

- ☐ for the Leak Detection Pump - V144-

8 - Leak Detection Pump - V144-

9 - Fuel Tank

10 - Cap



3.2.4 Leak Detection Pump - V144- , Checking Vacuum Supply

Special tools and workshop equipment required

- ◆ Turbocharger Tester Kit - VAG1397A-
- ◆ T-Connection - 251.201 346-
- ◆ Hose 6 mm diameter



Note

Leak Detection Pump - V144- installed location: inside the right rear wheel housing under the wheel housing liner.

- Remove the right rear wheel and wheel housing liner.



- Remove the vacuum line -1- from the Leak Detection Pump - V144-
- Connect the Turbocharger Tester Kit - VAG1397A- with the T-piece and 6 mm hose between the vacuum line -1- and the Leak Detection Pump - V144- -2-.
- Switch on the measuring range \square (absolute pressure measurement).
- Connect the vehicle diagnostic tester and start the engine.
- Select **Guided Functions** on the vehicle diagnostic tester.
- Select “Check tank ventilation system for leaks” guided function.
- Start the test.
- During the test, pay attention to the display on the Turbocharger Tester Kit - VAG1397A- .
- The pressure must pulsate and must not rise above 0.700 bar (absolute pressure) during the test.

If the pressure rises above 0.700 bar during the test, the vacuum supply is too low.

- Vehicles through MY 2009: make sure there the vacuum line leading to the intake manifold is not bent or plugged.
- Vehicles from MY 2010: make sure the vacuum line for the connection to the vacuum line between the vacuum pump and brake booster is not bent or plugged.

3.3 Fuel Tank, Checking Ventilation

Special tools and workshop equipment required

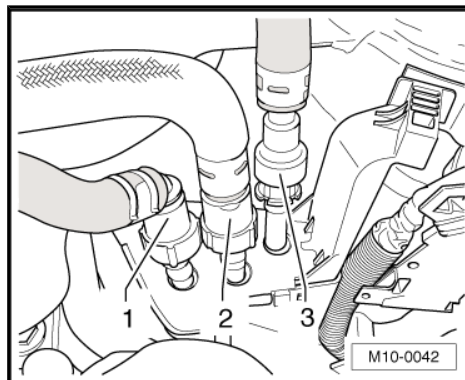
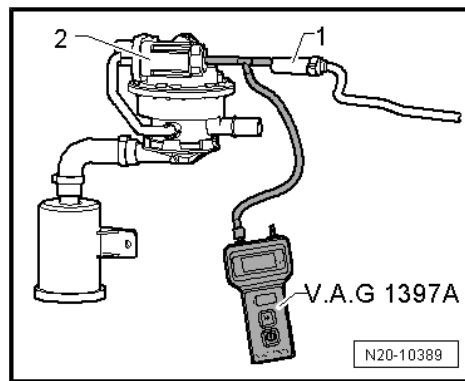
- ◆ Hand Vacuum Pump - VAS6213-
- ◆ Adapter set - VAG1318/17A-
- ◆ Fuel Injection Gauge Kit - Fuel Bleeder 20 Adapter 1 - VAG1318/20-1-

Test Conditions

- The ignition must be off.

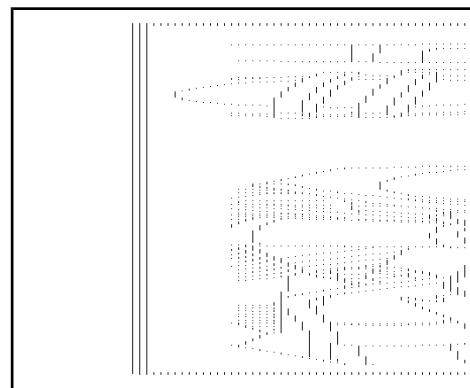
Test Sequence

- Separate the vent line -1-.
- Press in securing ring to release the line.



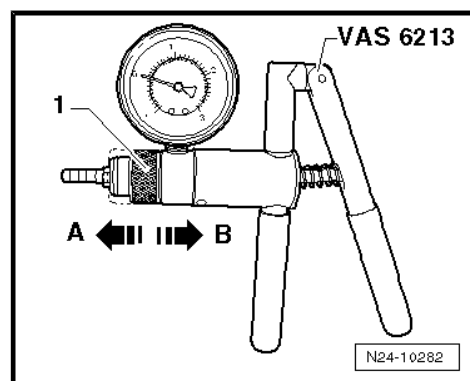


- Connect the Hand Vacuum Pump - VAS6213- -1- to the ventilation line -2- for the EVAP canister as illustrated.



- Set the slide ring -1- of the Hand Vacuum Pump - VAS6213- to position -A- for “vacuum”.
- Operate the Hand Vacuum Pump - VAS6213- several times.
 - No vacuum should be built up.

If a vacuum forms:



- Check the breather hole on the EVAP canister -arrow- for contamination and clean it if necessary.

If no vacuum forms:

- Seal the breather hole -arrow- and operate the vacuum pump several times again.
 - A vacuum must form.

If no vacuum forms:

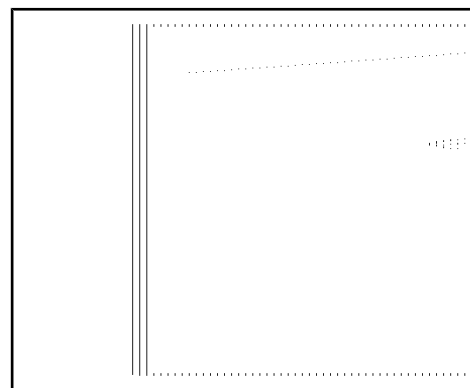
- Clamp off the hose between the EVAP canister and EVAP Canister Purge Regulator Valve 1 - N80- .
- Actuate the vacuum pump again a few times.

If no vacuum forms:

- Replace EVAP canister.

Vacuum:

- Replace the EVAP Canister Purge Regulator Valve 1 - N80- .





4 Removal and Installation

⇒ [“4.1 Fuel Tank, Draining”, page 172](#)

⇒ [“4.2 Fuel Delivery Unit”, page 177](#)

⇒ [“4.3 Fuel Level Sensor G”, page 179](#)

⇒ [“4.4 Fuel Tank”, page 181](#)

⇒ [“4.5 Fuel Filter”, page 183](#)

⇒ [“4.6 Fuel System, Bleeding”, page 184](#)

⇒ [“4.7 Accelerator Pedal Module”, page 186](#)

BGP, BGQ, CBTA and CBUA

⇒ [“4.8 EVAP Canister”, page 189](#)

BGP, BGQ, CBTA and CBUA

⇒ [“4.9 Leak Detection Pump V144”, page 190](#)

4.1 Fuel Tank, Draining

⇒ [“4.1.1 Fuel Tank, Draining with Fuel Pump Installed”, page 172](#)

BGP, BGQ, CBTA and CBUA

⇒ [“4.1.2 Fuel Tank, Draining, Fuel Pump Faulty”, page 174](#)

BTK and CCCA

⇒ [“4.1.3 Fuel Tank, Draining, Fault Fuel Pump”, page 175](#)

4.1.1 Fuel Tank, Draining with Fuel Pump Installed

Special tools and workshop equipment required

- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Fuel Extraction Unit - VAS5190-
- ◆ Wrench - Fuel Sending Unit - T10202-
- ◆ Fuel Extraction - Adapter 3 - VAS5190/3-
- ◆ Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565-
- ◆ Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A-
- Read the Safety Precautions before starting. Refer to
⇒ [“1.1 Safety Precautions, Working on Fuel Supply System”, page 139](#).

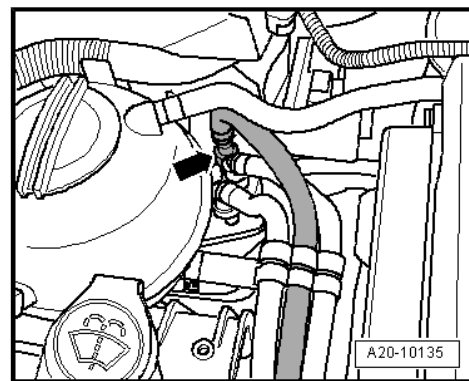


WARNING

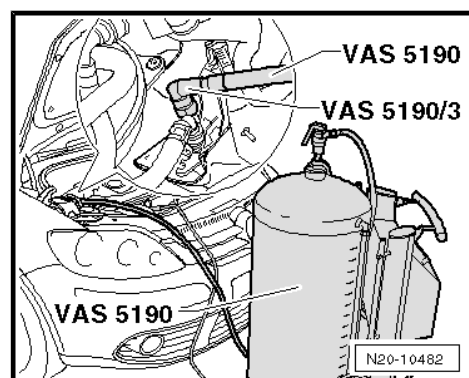
- ◆ *The fuel supply line is under pressure. Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin. Wrap a cloth around the connection before loosening hose connections. Remove the hose connection carefully to release the pressure.*
- ◆ *Connect the Fuel Extractor - VAS5190- ground strap with the ground.*



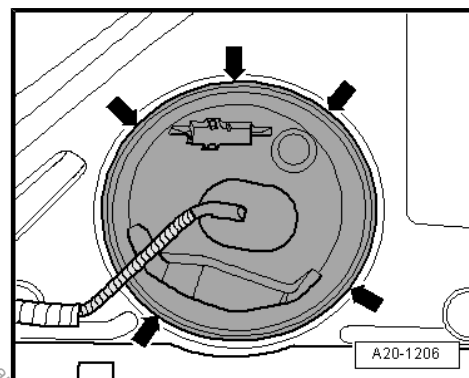
- Disconnect the fuel supply line -arrow-. To do so, press in securing ring.



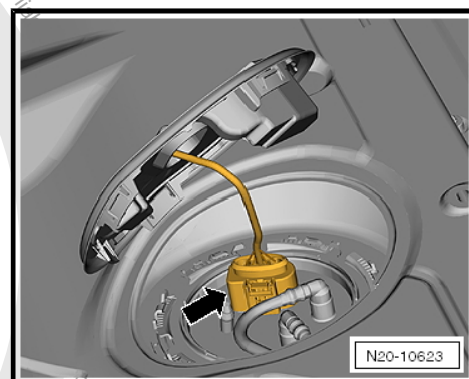
- Connect the Fuel Extraction Unit - VAS5190- and Fuel Extraction - Adapter 3 - VAS5190 /3- to the fuel supply line.
- Remove the bench seat. Refer to ➔ Body Interior; Rep. Gr. 72 ; Rear Seats; Bench Seat, Removing and Installing .



- Remove the cover from the fuel delivery unit.



- Disconnect the connector -arrow-.





- Attach the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- to the connector and to the fuel delivery unit.
- Connect the Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A- to the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- and battery positive (+).



Note

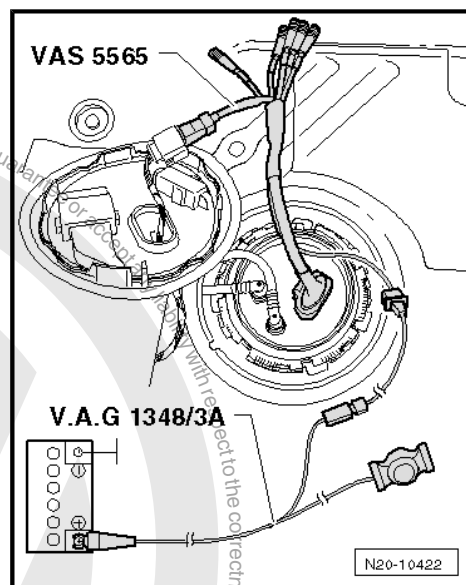
This work step allows the fuel pump to run when the engine is not running.

- Remove the fuel cap from the fuel filler tube.
- Operate the Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A- and the shut-off valve on the Fuel Extractor - VAS5190- until the fuel tank is empty.



Caution

Do not run the fuel pump when it is »dry«.



4.1.2 Fuel Tank, Draining, Fuel Pump Faulty

Special tools and workshop equipment required

- ♦ Torque Wrench 1332 40-200Nm - VAG1332-
- ♦ Fuel Extraction Unit - VAS5190-
- ♦ Wrench - Fuel Sending Unit - T10202-
- Read the Safety Precautions before starting. Refer to
⇒ ["1.1 Safety Precautions, Working on Fuel Supply System", page 139](#).



Note

- ♦ Vehicles with engine codes BGQ and CBUA have a bayonet connection.
- ♦ If the adapter is not available, the threaded part of the fuel siphoning unit must be held in place.
- ♦ The fuel tank has a check valve installed. Be careful not to damage this check valve while extracting fuel.

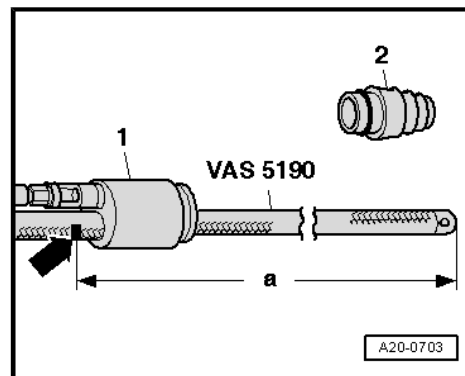


Caution

Secure the Fuel Extraction Unit - VAS5190- ground wire to a bare area of the chassis.



- Remove the cone piece -2- from the shaft piece -1- on the Fuel Extraction Unit - VAS5190- .
- Using insulating tape, apply a mark -arrow- on hose at the distance -a- = 1500 mm from end of suction hose.
- Remove the fuel cap from the fuel filler tube.

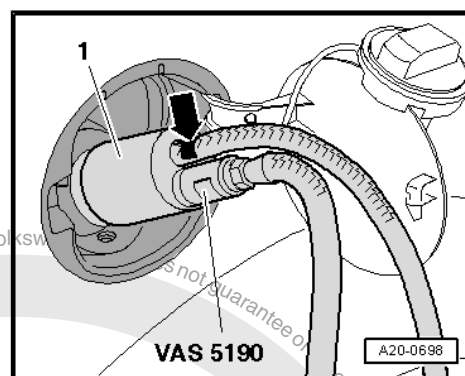


- Attach the shaft piece -1- from the Fuel Extraction Unit - VAS5190- to the filler neck on the fuel tank.
- Push the extractor hose into the fuel tank until it reaches the mark previously made on the shaft piece -arrow- and extract the fuel. Refer to the Fuel Extraction Unit - VAS5190- Operating Instructions.



Note

Fuel tank is drained almost completely.



Caution

Do not use force to pull the extractor hose if it gets stuck on the check valve.

- ◆ **In this case, remove the fuel delivery unit and manually hold the check valve open. When doing this, make sure the arm does not come in contact with the fuel.**

4.1.3 Fuel Tank, Draining, Fault Fuel Pump

Special tools and workshop equipment required

- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Fuel Extraction Unit - VAS5190-
- ◆ Wrench - Fuel Sending Unit - T10202-
- Read the Safety Precautions before starting. Refer to ["1.1 Safety Precautions, Working on Fuel Supply System", page 139](#) .



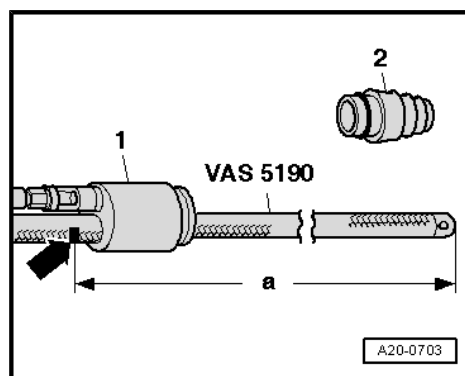
Caution

Secure the Fuel Extraction Unit - VAS5190- ground wire to a bare area of the chassis.

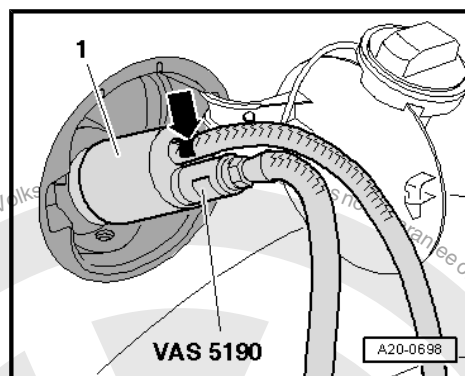


Fuel Tank, Draining When More than $\frac{3}{4}$ Full

- Remove the cone piece -2- from the shaft piece -1- on the Fuel Extraction Unit - VAS5190- .
- Using insulating tape, apply a mark on the hose -arrow- -a- = 1,180 mm from the end of the suction hose.



- Remove the fuel cap from the fuel filler tube.
- Attach the shaft piece -1- from the Fuel Extraction Unit - VAS5190- to the filler neck on the fuel tank.
- Slide suction hose as far into fuel tank until the mark applied earlier -arrow- stands on shaft piece.



Note

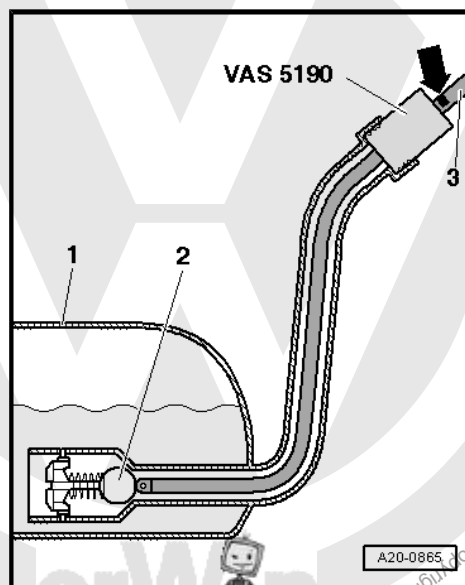
There is a ball valve -2- located at the lower end of the filler neck in the fuel tank -1- that must not be damaged by the suction hose -3-. Therefore slide in hose only up to the marking -arrow- applied earlier.

- Drain fuel tank as much as possible.
- Carefully pull out the suction hose.



Note

- ♦ *When no more fuel can be extracted, the tank is emptied only enough for the fuel delivery unit to be removed without danger.*
- ♦ *If fuel tank must be drained completely, proceed as follows:*



Fuel Tank, Draining When Less Than $\frac{3}{4}$ Full

- Switch off the ignition and all electrical consumers and remove the key.
- Remove the bench seat. Refer to ➤ Body Interior; Rep. Gr. 72 ; Rear Seats; Bench Seat, Removing and Installing .



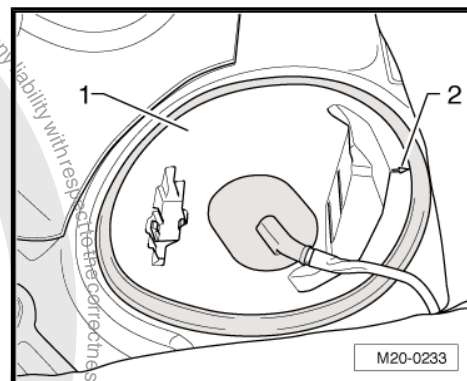
- Unclip the cover -1- from the fuel delivery unit. The arrow -2- points in direction of travel.



WARNING

Fuel system is under pressure!

- ◆ **Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.**
- ◆ **Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.**

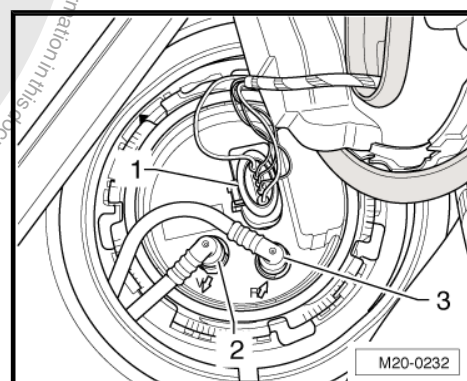


- Disconnect the 5-pin connector -1-, the black supply line -2- and the blue return line -3-.



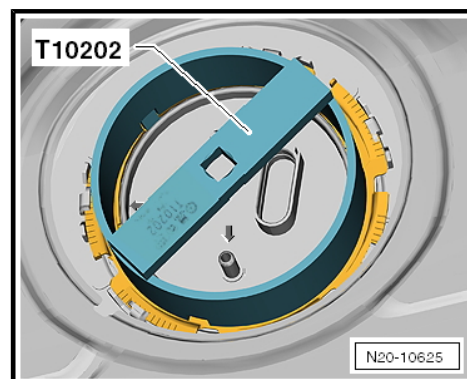
Note

Press in securing ring to disengage the lines.



- Open locking ring using Wrench - Fuel Sending Unit - T10202- .
- Pull out fuel delivery unit slightly.
- Insert the Fuel Extraction Unit - VAS5190- suction hose as far as possible into the fuel tank and extract the fuel.

If fuel tank needs only to be drained, install fuel delivery unit again.
Refer to ➤ ["4.2 Fuel Delivery Unit", page 177](#) .



4.2 Fuel Delivery Unit

Special tools and workshop equipment required

- ◆ Wrench - Fuel Sending Unit - T10202-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-

Removing



Caution

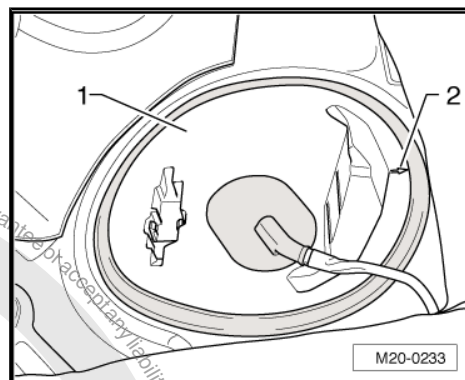
Conditions:

- **Fuel tank may be a maximum of $\frac{3}{4}$ full. This ensures the fuel level is below the fuel delivery unit flange.**

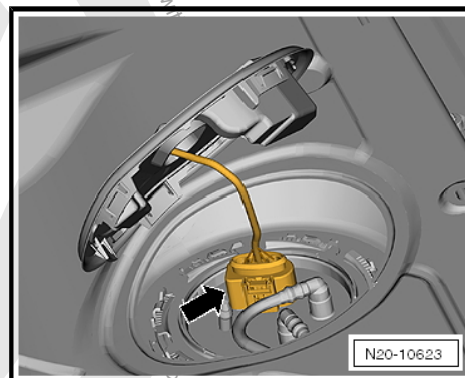


Note

- ◆ When replacing the fuel delivery unit, check the fuel tank for visible contamination and clean if necessary.
- ◆ If necessary, empty the fuel tank using the Fuel Extraction Unit - VAG5190-. Refer to
⇒ ["4.1 Fuel Tank, Draining", page 172](#) .
- ◆ Follow all safety precautions. Refer to
⇒ ["1.1 Safety Precautions, Working on Fuel Supply System", page 139](#) .
- ◆ Follow the guidelines for clean working conditions. Refer to
⇒ ["1.2 Clean Working Conditions", page 140](#) .
- Switch off the ignition and all electrical consumers and remove the key.
- Remove the bench seat. Refer to ⇒ Body Interior; Rep. Gr. 72 ; Rear Seats; Bench Seat, Removing and Installing .
- Unclip the cover -1- from the fuel delivery unit. The arrow -2- points in direction of travel.



- Pull on the connector -arrow- without pressing the retainer to make sure it is connected securely. If the connector was not connected correctly, it could cause a fault.
- Disconnect the connector.
- Check the contacts on the connector and the fuel delivery unit for damage.



WARNING

Fuel system is under pressure!

- ◆ Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.
- ◆ Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.

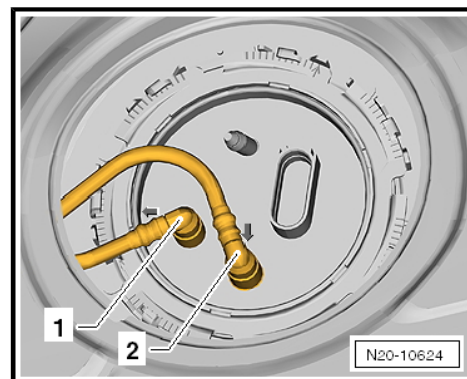


- Remove the fuel lines -1- and -2- from the flange.



Note

Press the locking ring to release the fuel lines.

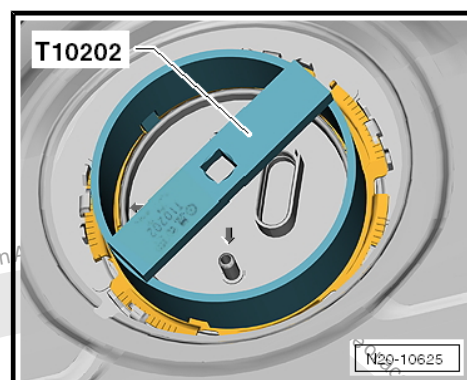


- Open locking ring using Wrench - Fuel Sending Unit - T10202- .
- Pull fuel delivery unit with sealing ring out of fuel tank opening.



Note

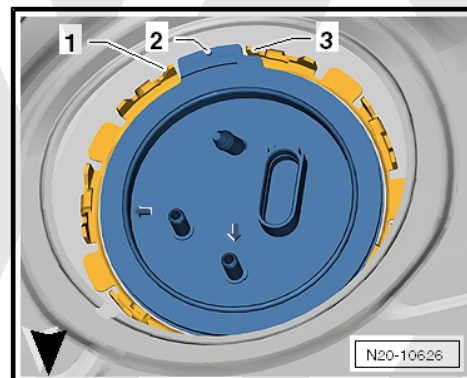
- ◆ *When removing fuel delivery unit, be sure not to bend sender for fuel gauge.*
- ◆ *When replacing fuel delivery unit, empty old fuel delivery unit before disposing.*



Installing

Installation of the fuel delivery unit is performed in the reverse order of removal. Note the following:

- ◆ Insert dry new sealing ring of fuel delivery unit into opening of fuel tank.
- ◆ Only coat seal with fuel on the inside when installing fuel delivery unit.
- ◆ Do not bend the Fuel Level Sensor -G- when inserting the fuel delivery unit.
- ◆ Press the sealing flange downward against the spring force and bring it into the installation position.
- ◆ Pay attention when installing the fuel delivery unit: the tab -2- on the fuel delivery unit must be between -1- and -3-. The -arrow- points in the direction of travel.
- ◆ Tighten the locking ring to 110 Nm.
- ◆ Do not interchange black supply line and blue return line (arrows on flange of fuel delivery unit).
- ◆ Make sure the connectors and the fuel line are secure. Pull on them if necessary.
- ◆ After installing fuel delivery unit, check whether supply and return lines are still clipped in at fuel tank.



4.3 Fuel Level Sensor - G-



Note

Fuel delivery unit running change with updated Fuel Level Sensor - G- .



Removing - old version

- Remove fuel delivery unit. Refer to
⇒ [“4.2 Fuel Delivery Unit”, page 177](#) .
- Note the color of the wire for installing later.
- Release connectors -arrows- and remove electrical wires
-1, 2 and 3-.
- Lift retaining tabs -4- and -5- with a screwdriver and pull the
Fuel Level Sensor - G- downward and off -arrow-.

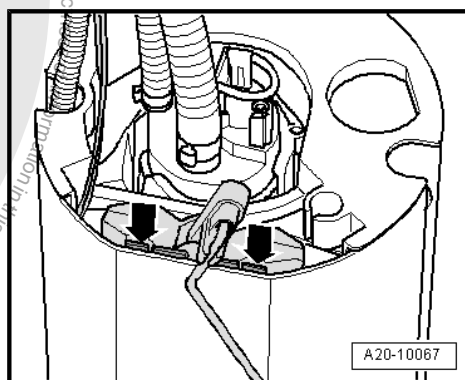
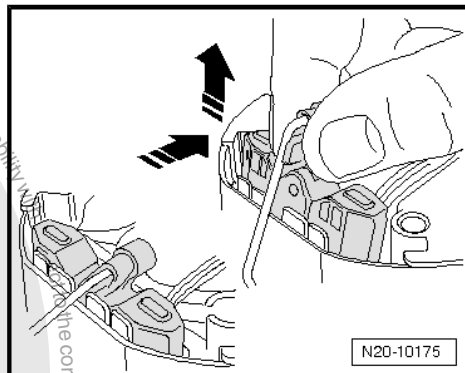
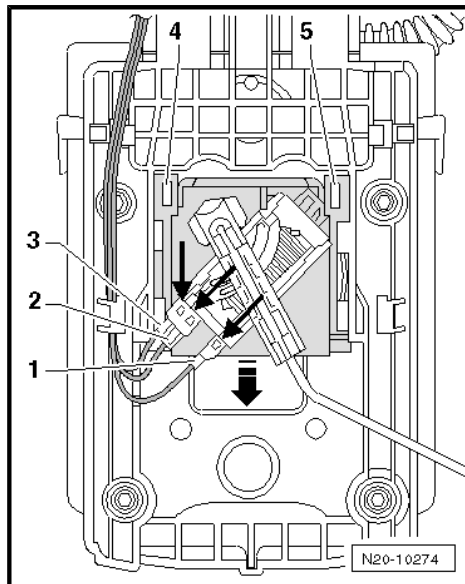
Installing - old version

- Insert fuel gauge sender into the guides on the fuel delivery unit and push up until it engages.
- Connect the connector. Pay attention to the color coding.
- Pull on the connector to make sure it is secure.
- Install the fuel delivery unit. Refer to
⇒ [“4.2 Fuel Delivery Unit”, page 177](#) .

Removing - new version

- Remove fuel delivery unit. Refer to
⇒ [“4.2 Fuel Delivery Unit”, page 177](#) .
- Pull the Fuel Level Sensor - G- slightly to the side and upward
at the same time.

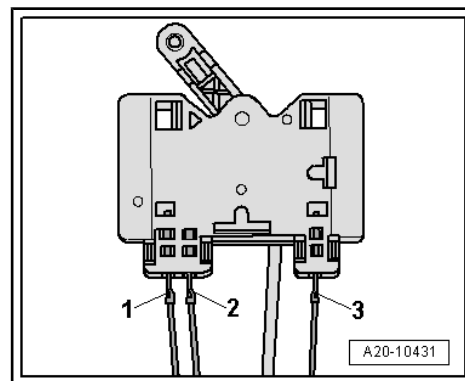
If the sensor cannot be released this way, also press the re-
taining tab -arrows- to the side slightly.



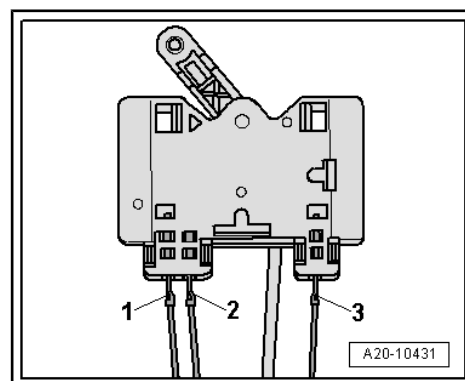


- Note the color of the wire for installing later.
- Disconnect the connectors -1 through 3-. Bend the hooks back.

Installing - new version



- Connect the connectors -1 through 3-. Pay attention to the color coding.
- Pull on the connector to make sure it is secure.
- Insert Fuel Level Sensor - G- into guide at fuel delivery unit and press down until engagement.
- Install the fuel delivery unit. Refer to [⇒ "4.2 Fuel Delivery Unit", page 177](#) .



4.4 Fuel Tank

Special tools and workshop equipment required

- ◆ Torque Wrench 1331 5-50Nm - VAG1331-

Removing

- Fuel tank may be a maximum of $\frac{1}{4}$ full.



Note

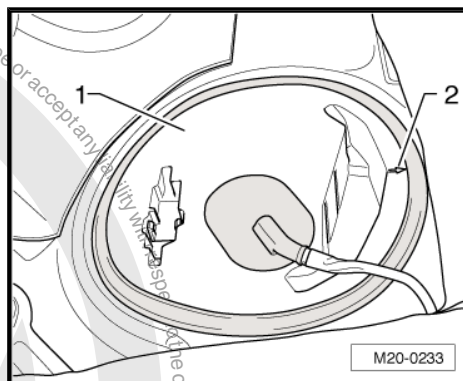
- ◆ *If necessary, empty the fuel tank using the Fuel Extraction Unit - VAG5190-. Refer to [⇒ "4.1 Fuel Tank, Draining", page 172](#) .*
- ◆ *Read the Safety Precautions before starting. Refer to [⇒ "1.1 Safety Precautions, Working on Fuel Supply System", page 139](#) .*
- ◆ *Follow all the rules of cleanliness. Refer to [⇒ "1.2 Clean Working Conditions", page 140](#) .*

Turn off the ignition and all electric consumers and remove the key.

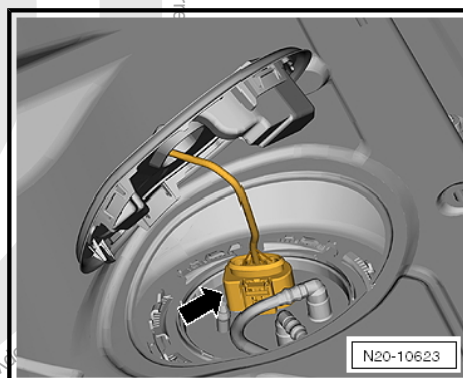
- Open the fuel filler door and remove the fuel cap.
- Remove the bolts from the fuel filler door unit and then remove the fuel filler door unit. Refer to [⇒ Body Exterior; Rep. Gr. 55 ; Fuel Filler Door Unit](#).
- Remove the bench seat. Refer to [⇒ Body Interior; Rep. Gr. 72 ; Rear Seats; Bench Seat, Removing and Installing](#) .



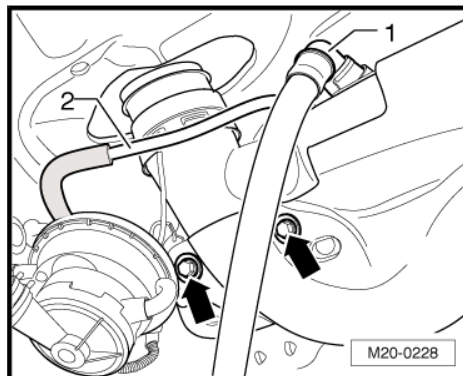
- Unclip cover -1- for fuel delivery unit. The arrow -2- points in direction of travel.



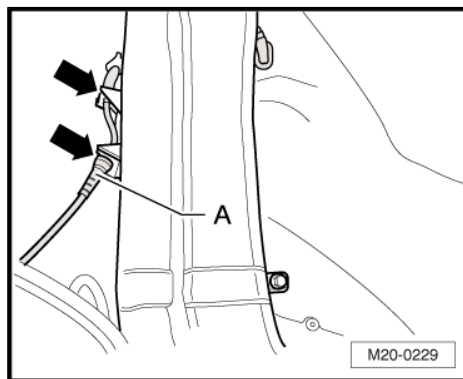
- Disconnect the connector -arrow- from the fuel delivery unit.
- Remove the right rear wheel housing liner. Refer to ➤ Body Exterior; Rep. Gr. 66 ; Wheel Housing Liner .



- Disconnect the connectors -1- and -2- (BGP, BGQ, CBTA, CBUA engines only).
- Remove the fuel filler tube -arrows-.



- Remove the ABS wire -A- from the bracket -arrows-.
- Remove the center muffler. It may be necessary to separate the center and rear mufflers beforehand. Refer to ➤ ["4.2 Middle and Rear Mufflers, Separating and Connecting"](#), page 247 .



WARNING

Fuel system is under pressure!

- ◆ ***Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.***
- ◆ ***Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.***

- Disconnect the breather line from the EVAP canister at the connection behind the fuel tank (engine codes BGP, BGQ, CBTA and CBUA only).

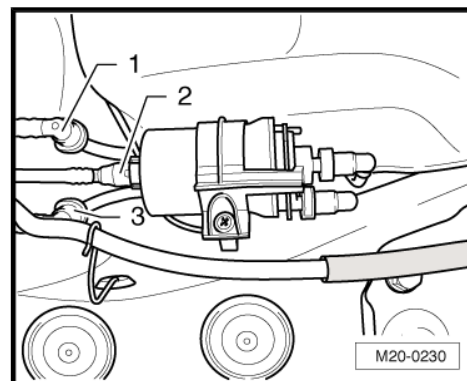


- Separate the white vent line -1-, black supply line -2- and green vacuum line for the Leak Detection Pump - V144- -3- at connecting point (engine codes BGP, BGQ, CBTA and CBUA only).



Note

- ◆ Press in securing ring to disengage the lines.
- ◆ A second technician will be needed to support the fuel tank.

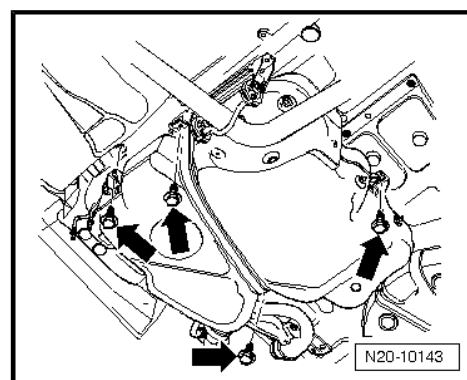


- Remove the mounting strap and bolts -arrows-.
- Remove the fuel tank.

Installing

Install in reverse order of removal. Note the following:

- ◆ Only use bolts with loose washers to secure the fuel tank mounting straps. The tension straps could twist when the bolts are tightened if other bolts are used.
- ◆ Make sure vent and fuel lines are not kinked.
- ◆ Do not interchange supply and return line (supply line black, return line blue).
- ◆ Make sure the connectors and the fuel line are secure. Pull on them if necessary.
- ◆ Check the fuel tank/body ground connection on the filler tube.
- ◆ Make sure the lines are still attached to the fuel tank after installing the fuel tank.
- Bleed the fuel system. Refer to ["4.6 Fuel System, Bleeding", page 184](#).



Tightening specifications:

Component	Nm
Fuel tank to chassis - M6	11
Fuel tank to chassis - M8	26
◆ Replace bolts	

4.5 Fuel Filter

Special tools and workshop equipment required

- ◆ Fuel container

Removing



Note

- ◆ Follow all safety precautions. Refer to ["1.1 Safety Precautions, Working on Fuel Supply System", page 139](#).
- ◆ Follow the guidelines for clean working conditions. Refer to ["1.2 Clean Working Conditions", page 140](#).
- Switch off the ignition and all electrical consumers and remove the key.



- Place container underneath fuel filter.



WARNING

Fuel system is under pressure!

- ◆ **Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.**
- ◆ **Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.**

- Disconnect the fuel lines -1-, -2- and -3- by pressing in the circlip.
- Remove the bolt -4-.
- Remove fuel filter.

Installing

Install in reverse order of removal. Note the following:

The direction of flow is marked on filter housing with arrows.

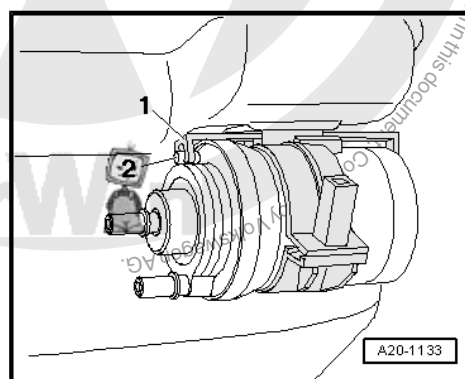
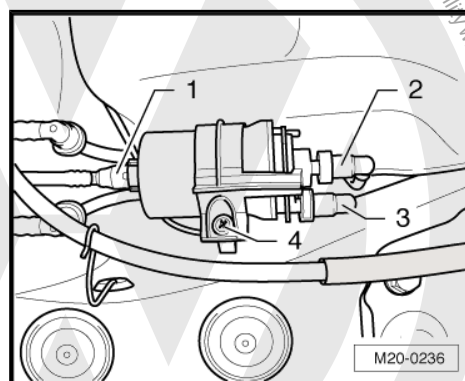
- Bleed the fuel system. Refer to
⇒ [“4.6 Fuel System, Bleeding”, page 184](#).

Installation Position

Pin -2- on filter housing must engage in recess of guide -1- on filter bracket.

Tightening Specification:

Component	Nm
Screw clip for fuel filter	3



4.6 Fuel System, Bleeding

Special tools and workshop equipment required

- ◆ Fuel Injection Gauge Kit - Fuel Bleeder 20 - VAG1318/20-
- ◆ Suction Pump - VAS5226-
- ◆ Vehicle Diagnostic Tester



Note

- ◆ **If fuel supply system was opened, it must always be bled before starting engine.**
- ◆ **If fuel supply system is not bled, catalytic converter will be damaged.**
- ◆ **Follow all the rules of cleanliness. Refer to**
⇒ [“1.2 Clean Working Conditions”, page 140](#).



Procedure

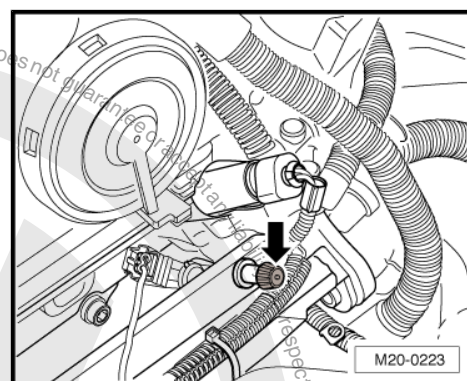


WARNING

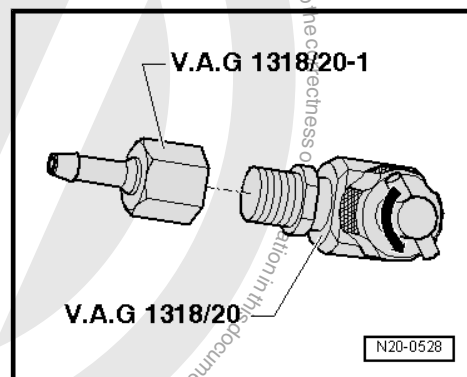
Fuel system is under pressure!

- ◆ ***Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.***
- ◆ ***Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.***

- Remove the cap -arrow- from the bleed valve.



- Turn valve (on T-piece) counter-clockwise until it is completely open.
- Thread the Fuel Injection Gauge Kit - Adapter 1 - VAG1318/20-1- on the Fuel Injection Gauge Kit - Fuel Bleeder 20 -VAG1318/20-.
- Now attach the Fuel Injection Gauge Kit - Fuel Bleeder 20 - VAG1318/20- hand-tight on the bleeder valve.





- Connect the hose from the Suction Pump - VAS5226- as illustrated.
- Turn valve (at T-piece) clockwise into bleeder valve to stop.
- Check adapter and hose connection for leaks.

Connect the Vehicle Diagnostic Tester as follows:

- Connect the diagnostic cable connector -2- to the diagnostic connection inside the driver footwell.
- Press the following buttons on the display one after another:

OBD

OBD ▶

Engine electronics ▶

Output diagnostic test ▶

- Keep pressing ▶ until the fuel pump relay - J17 activates. This activates the fuel pump. Let the diagnostic run until fuel without bubbles runs out of the bleeder valve. Then end output diagnostic test mode.

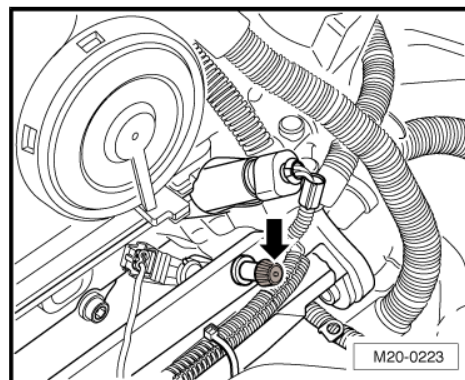
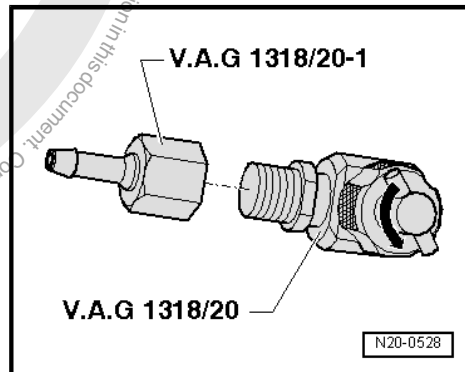
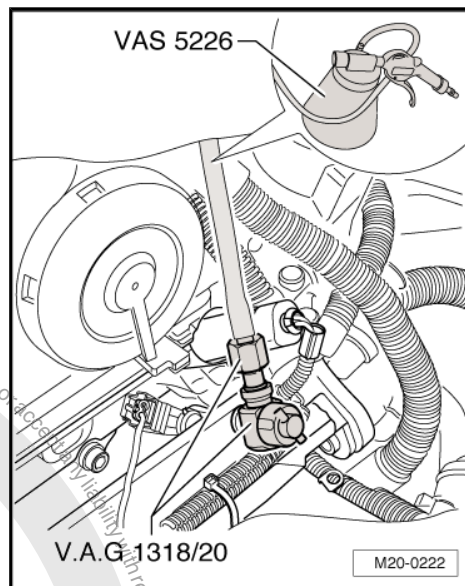


Note

If the output diagnostic test mode is interrupted, the engine must be started for a short time before the mode can be accessed again. Output diagnostic test mode is automatically cancelled after 60 seconds.

- Turn valve at T-piece counterclockwise until it is completely open again.
- Clamp the hose of the Suction Pump - VAS5226- (for example, with Hose Clamps - Up To 25mm -3094-) and remove it from the Fuel Injection Gauge Kit - Adapter 1 -VAG1318/20-1- .
- Remove the Fuel Injection Gauge Kit - Adapter -VAG1318/20- from the bleeder valve.

- Install the bleed valve cap -arrow-.



4.7 Accelerator Pedal Module

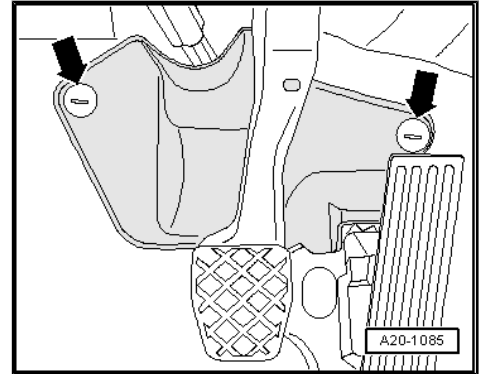
Special tools and workshop equipment required

- ♦ Accelerator Pedal Module Release Tool - T10238-

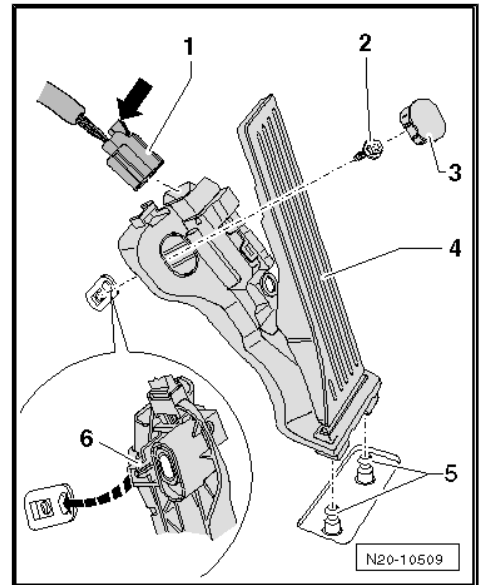


Removing

- Remove the steering column cover -arrows-.

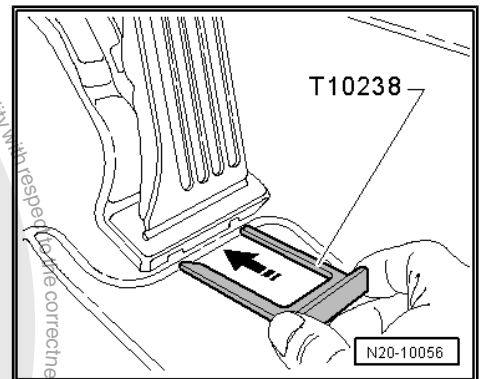


- Pry off the cap -3- using a screwdriver.
- Remove bolts -2-.
- Disconnect the connector -1-. Refer to ➤, [page 188](#) .
- Install the Accelerator Pedal Module Release Tool - T10238- all the way into the opening as illustrated.



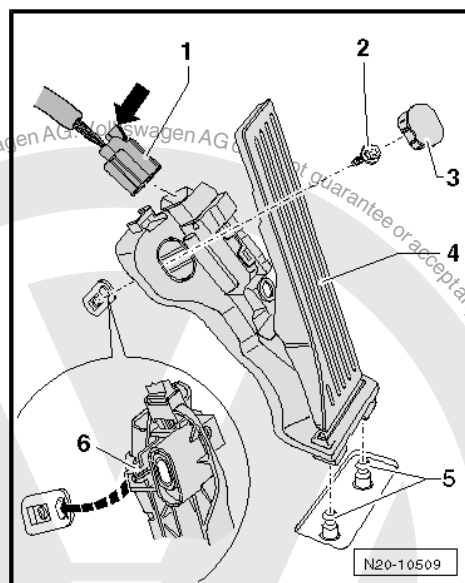
- Remove the accelerator pedal module.

Installing





- Connect the connector -2- to the accelerator pedal module -5-. Refer to ➤ , [page 188](#) .
- Push the accelerator pedal module onto the bolt -5-.
- Insert the centering pin -6- into the hole in the floor panel.
- Secure the accelerator pedal module with the bolt -2-.
- Install the cap -3-.



- Install the steering column cover -arrows-.
- If the accelerator pedal module was replaced, adapt it to the engine control module using the Vehicle Diagnostic Tester in "Guided Functions".
- If the accelerator pedal module was replaced on vehicles with an automatic transmission, then the kick-down function must be adapted using the Vehicle Diagnostic Tester in "Guided Functions".

Tightening specification:

Component	Nm
Accelerator pedal module to body	10

Accelerator Pedal Module Connector, Disconnecting and Connecting



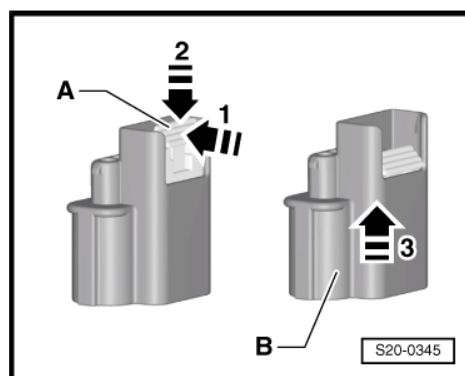
Note

The accelerator pedal modules have connectors, which are disconnected and connected differently.

Disconnecting connector 1K0 973 706

- Push the slider -A- (gray) in direction of -arrow 1- and then all the way down direction of -arrow 2-.
- Hold the slider in this position and remove the connector housing -B- in direction of -arrow 3-.

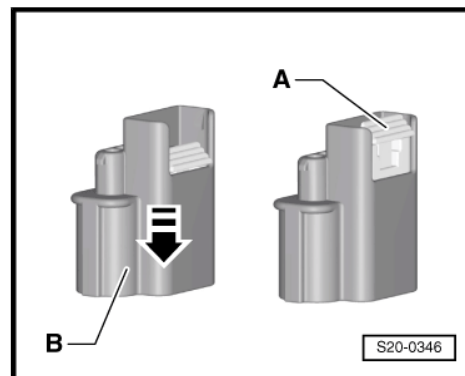
The slider -A- stays in the lower position.





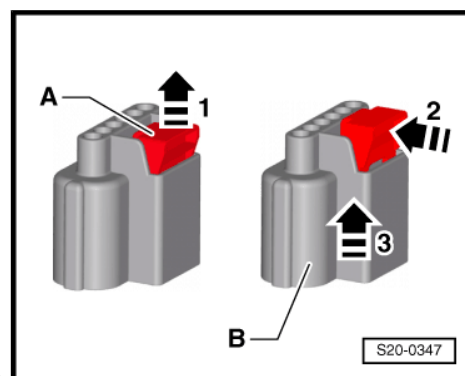
Connecting connector 1K0 973 706

- Push the connector housing -B- in direction of -arrow- until the housing clicks into place.
 The slider -A- automatically moves upward.
- Pull on the connector to make sure it is secure.



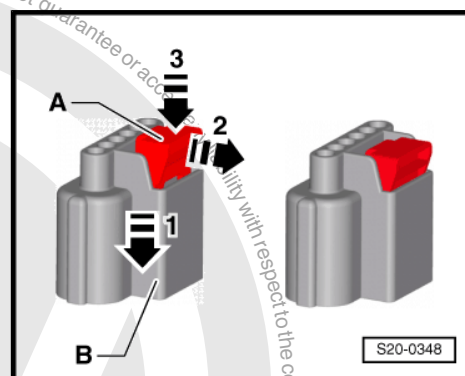
Disconnecting connector 8K0 973 706

- Pull the slider -A- (red) all the upward in direction of -arrow 1-.
 - Push the slide in direction of -arrow 2- and remove the connector housing -B- upward in direction of -arrow 3-.
- The slider -A- stays in the upper position.



Connecting connector 8K0 973 706

- Push the connector housing -B- all the way down in direction of -arrow 1-.
 - Push the slider in direction of -arrow 2- and downward in direction of -arrow 3-.
- The slider -A- can be pushed down only if the connector housing was pushed »all the way down«.
- Pull on the connector to make sure it is secure.

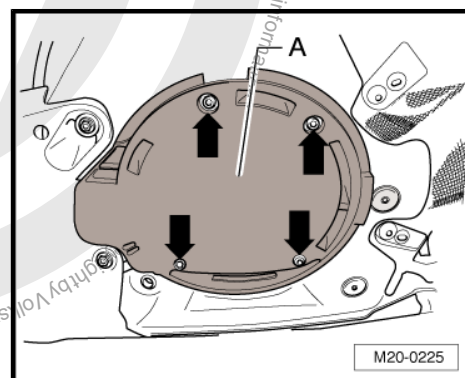


4.8 EVAP Canister

Removing

- Remove the cover -A-.

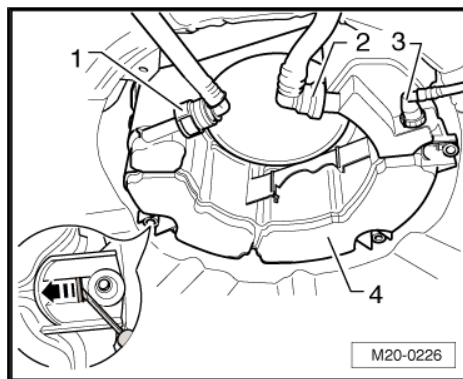
Vehicles with engine code BGP and CBTA





- Disconnect the lines -1-, -2- and -3-. To do so, press in or press together securing ring.
- Press the retainers on the attaching points with a screwdriver in the direction of -arrow- and remove the EVAP canister -4-.

Vehicles with engine code BGQ and CBUA



- Perform removing the same way as on vehicles with code letters BGP and CBTA.

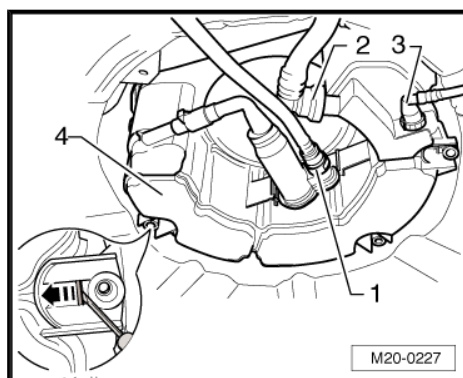
Installing

Install in reverse order of removal. Note the following:

- ◆ Connect ventilation lines until they engage audibly.
- ◆ Make sure that the lines and the EVAP canister are securely engaged.

Tightening Specification:

Component	Nm
EVAP canister to body	8



4.9 Leak Detection Pump - V144-

Removing

- Remove the right rear wheel housing liner. Refer to ➤ Body Exterior; Rep. Gr. 66 ; Wheel Housing Liner .
- Remove the vacuum line -2-.
- Disconnect the connector -3-.
- Press the release button and disconnect the breather line -4-.
- Remove the cap nuts -1-.
- Disengage diagnostic pump with bracket.

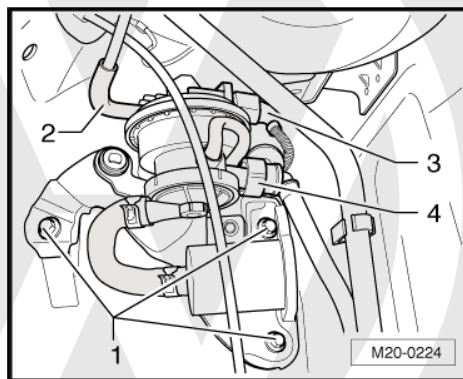
Installing

Install in reverse order of removal. Note the following:

- ◆ The vent line -4- must engage audibly.
- ◆ Make sure the lines are connected securely.

Tightening Specification:


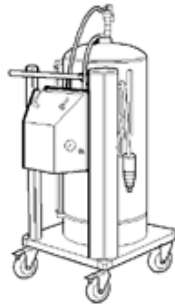
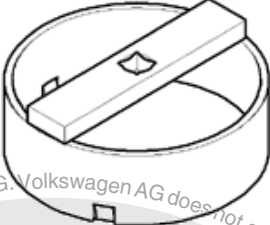
Component	Nm
Bracket for leak detection pump to wheel housing	9



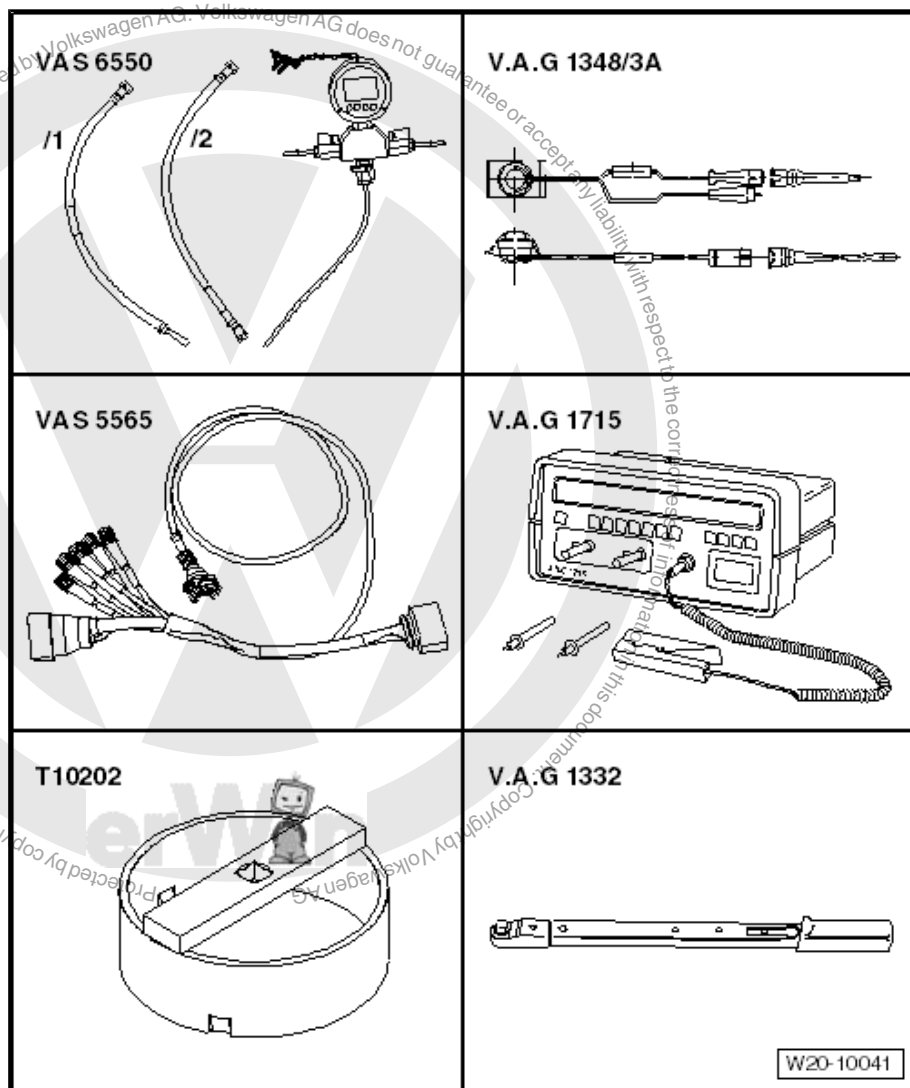


5 Special Tools

Special tools and workshop
 equipment required

<p>V.A.G 1332</p> 	<p>VAS 5190</p> 
<p>T10202</p> 	
	<p>120-0003</p>

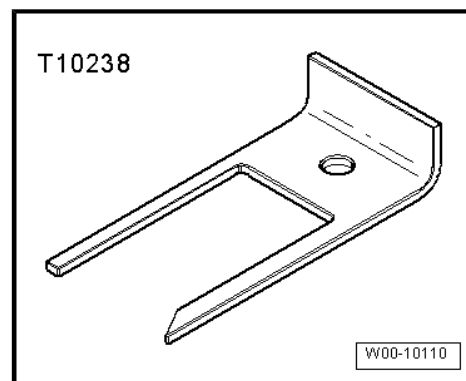
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Fuel Extraction Unit - VAS5190-
- ◆ Wrench Fuel Sending Unit - T10202-



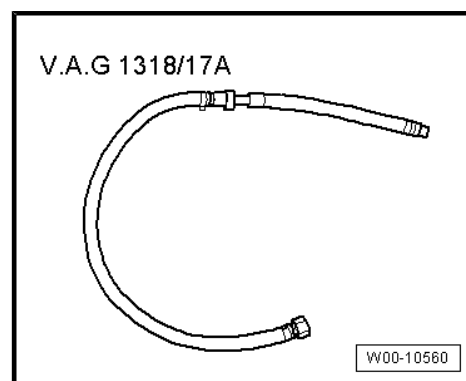
- ◆ Pressure Tester Kit - VAS6550-
- ◆ Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A-
- ◆ Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565-
- ◆ Analog/Digital Multimeter - FLU83III-
- ◆ Wrench - Fuel Sending Unit - T10202-
- ◆ Torque Wrench 1332 40-200Nm - VAG1332-
- ◆ Evaporative Emissions Tester - KLI9210-
- ◆ Evaporative Emissions Tester - Adapter 55 - KLI9210/55-1-



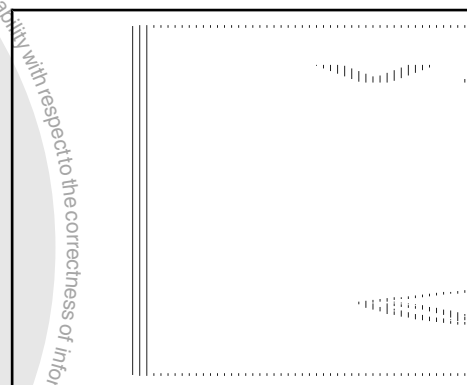
◆ Accelerator Pedal Module Release Tool - T10238-



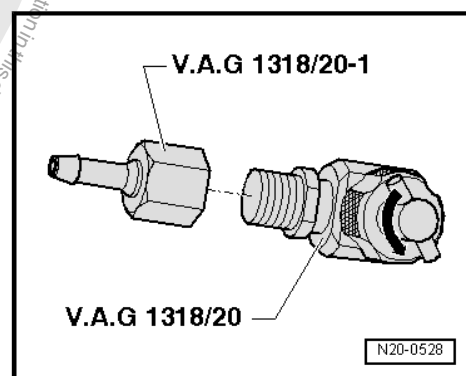
◆ Adapter set - VAG1318/17A-



◆ Fuel Injection Gauge Kit - Fuel Bleeder 20 - VAG1318/20-

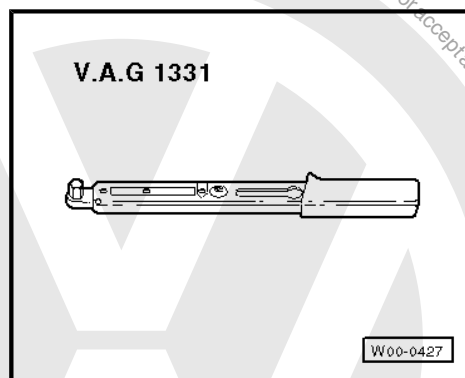


◆ Fuel Injection Gauge Kit - Fuel Bleeder 20 Adapter 1 - VAG1318/20-1-

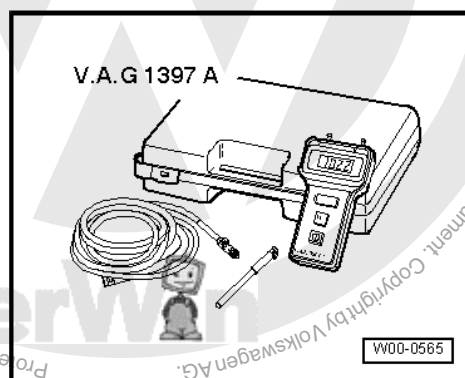




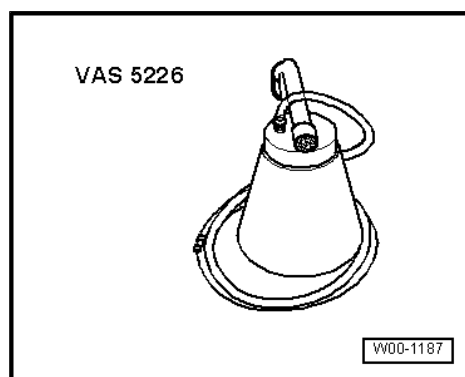
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-



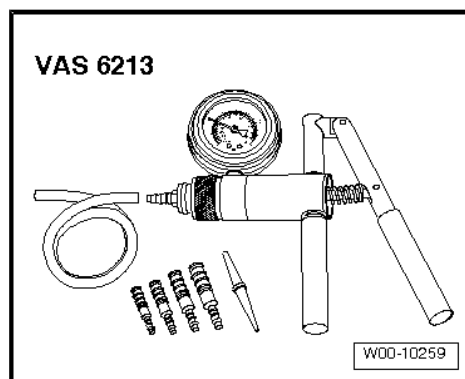
- ◆ Turbocharger Tester Kit - VAG1397A-



- ◆ Fuel Extraction - Adapter 3 - VAS5190/3-
- ◆ Suction Pump - VAS5226-



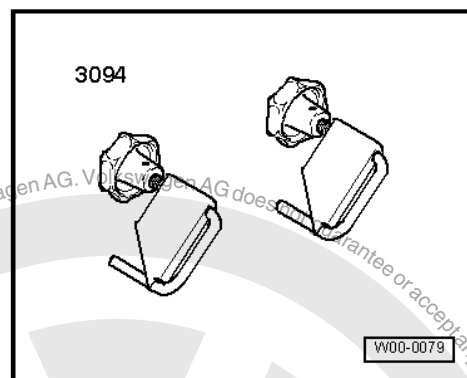
- ◆ Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565-
- ◆ Hand Vacuum Pump - VAS6213-



- ◆ Voltage Tester - VAS6839-



◆ Hose Clamps - Up To 25 mm - 3094-





24 – Multiport Fuel Injection

1 General Information

⇒ [“1.1 Fuel Injection System, General Information”, page 196](#)

⇒ [“1.2 Safety Precautions”, page 197](#)

⇒ [“1.3 Clean Working Conditions”, page 197](#)

⇒ [“1.4 Technical Data”, page 198](#)

1.1 Fuel Injection System, General Information

- ◆ The Mass Airflow Sensor - G70- is no longer installed from MY 2009. The intake air temperature sensor - G42- is installed on the intake manifold with the Manifold Absolute Pressure Sensor - G71- .
- ◆ Bleed the fuel system before starting the engine if the fuel system was opened earlier. Refer to
⇒ [“4.6 Fuel System, Bleeding”, page 184](#) .
- ◆ Fuel hoses in engine compartment may only be secured with spring-type clamps, Allocation. Refer to the Parts Catalog. The use of clamp or screw type clips is not permissible.
- ◆ Ignition must be switched off when disconnecting the battery. Obtain radio code for radios with anti-theft coding before disconnecting battery.
- ◆ Follow all safety precautions after connecting Battery⇒ Electrical Equipment; Rep. Gr. 27 ; Disconnecting and Connecting Battery .
- ◆ For trouble-free operation of the electrical components a voltage of at least 11.5 V is necessary.
- ◆ Do not use sealants containing silicone. Particles of silicone drawn into the engine, will not be burnt in the engine and damage the oxygen sensor.
- ◆ If the engine only starts briefly and then turns off again after troubleshooting, repairs or checking the components, it may be that the immobilizer is blocking the engine control module. The engine control module may have to be adapted then use the Vehicle Diagnostic Tester in “Guided Functions”.
- ◆ It is possible that the control module will recognize a malfunction and store a DTC during some tests. Therefore after completing all checks and repairs the DTC memory must be checked and if necessary erased. Refer to
⇒ [“3.3 Engine Control Module DTC Memory, Checking and Erasing”, page 214](#) .
- ◆ Vehicles with an airbag are equipped with an emergency fuel shut-off system. It reduces the risk of fire in an accident because the fuel pump relay switches the fuel pump off.
- ◆ When the driver-side door is opened, the fuel pump is activated for 2 seconds so that pressure builds in the fuel system. This improves comfort of engine start-up behavior.

Follow all Safety Precautions. Refer to
⇒ [“1.2 Safety Precautions”, page 197](#) .

Follow the guidelines for clean working conditions. Refer to
⇒ [“1.3 Clean Working Conditions”, page 197](#) .

Technical Data. Refer to ⇒ [“1.4 Technical Data”, page 198](#) .



1.2 Safety Precautions



WARNING

Fuel system is under pressure!

- ◆ *Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.*
- ◆ *Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.*

To reduce the risk of personal injury and/or damage to the fuel injection and ignition system, always observe the following:

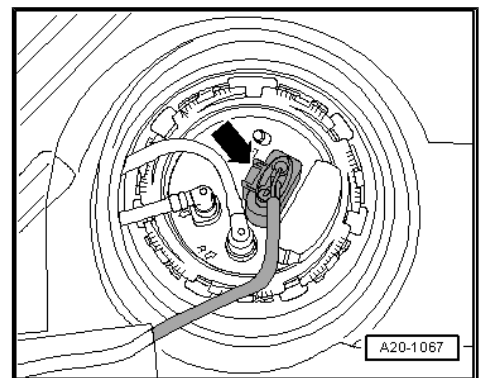
- ◆ Do not touch or remove ignition wires when engine is running or turning at starter speed.
- ◆ Only disconnect and reconnect wires for injection and ignition system, including test leads, if ignition is turned off.
- ◆ Fuel pump is activated with switching on the ignition and by door contact switch on the driver door. If the battery was not disconnected, the connecting piece -arrow- must be disconnected from the fuel delivery unit or the fuse for the Fuel Pump Control Module - J538- must be removed before opening the fuel system.



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.*



If special testing equipment is required during road test, note the following:

- ◆ Test equipment must always be secured to the rear seat and operated from there by a second person.

If test and measuring instruments are operated from the front passenger seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

- To complete the procedure, erase the engine control module DTC memory, because DTCs were stored in memory when fuse was removed. Refer to [⇒ "3.3 Engine Control Module DTC Memory, Checking and Erasing", page 214](#).

1.3 Clean Working Conditions

When working on the fuel supply/injection system, pay careful attention to the following "5 rules" of cleanliness:

- ◆ Thoroughly clean the connecting points and the surrounding area before loosening.



- ◆ Place the removed parts on a clean surface and cover them. Only use lint-free cloths!
- ◆ Carefully cover or seal opened components if the repair will not be done immediately.
- ◆ Install only clean parts: remove the replacement parts from their packaging just before installing them. Do not use parts that have been stored loose (for example, in tool boxes etc.).
- ◆ When the fuel system is open: avoid working with compressed air if possible. Do not move vehicle unless absolutely necessary.

1.4 Technical Data

Engine Code		BGP, BGQ, BTK	CBTA, CBUA, CCCA
Idle check			
Engine idle speed ⁹⁾	RPM	680	680
Engine Control Module ¹⁰⁾			
System designation		Motronic ME 7.1.1 from MY 2009 Motronic ME 17.5	Motronic ME 7.1.1 from MY 2009 Motronic ME 17.5 ⁸⁾
Replacement part number		Refer to the Parts Catalog.	Refer to the Parts Catalog.
Engine speed (RPM) limitation	RPM	approximately 5800	approximately 6300

8) Engine code CCCA from 12/2008, Motronic ME 17.5

9) Applies to manual and automatic transmission. If voltage supply of Engine Control Module (ECM) drops below 12 volts, idle speed is raised in stages up to 780 RPM. Idle speed is not adjustable.

10) Engine Control Module, Replacing. Refer to
⇒ ["4.5 Engine Control Module, through 10/2008", page 223](#).



2 Description and Operation

⇒ [“2.1 Overview - Component Locations”, page 199](#)

BGP and BGQ

⇒ [“2.2 Overview - Intake Manifold with Attachments”, page 202](#)

CBTA and CBUA

⇒ [“2.3 Overview - Intake Manifold with Attachments”, page 203](#)

BTK and CCCA

⇒ [“2.4 Overview - Intake Manifold with Attachments”, page 204](#)

⇒ [“2.5 Overview - Fuel Rail with Fuel Injectors”, page 205](#)

⇒ [“2.6 Overview - Air Filter”, page 206](#)

2.1 Overview - Component Locations

Fuel Injection System



Note

The Mass Airflow Sensor - G70- is no longer installed from MY 2009. The intake air temperature sensor - G42- is installed on the intake manifold with the Manifold Absolute Pressure Sensor - G71-.

The following components are not displayed in the component location - overview:

Manifold Absolute Pressure Sensor - G71-

- ◆ Component location: under the Throttle Valve Control Module - J338-

Accelerator Pedal Position Sensor - G79- / Accelerator Pedal Position Sensor 2 - G185-

- ◆ Component location: inside the accelerator pedal

Leak Detection Pump - V144-

- ◆ Component location: under the wheel housing liner inside right rear wheel housing

Clutch Position Sensor - G476-

- ◆ Only for vehicles with a manual transmission
- ◆ Component location: on the clutch master cylinder



1 - Cylinder 1 through 5 Fuel Injectors - N30, N31, N32, N33 and N83-

- ❑ Removing and installing. Refer to ➤ ["4.4 Fuel Injectors, Removing and Installing", page 221](#) .

2 - Camshaft Position Sensor - G40-

3 - Connecting Piece, 81-Pin

- ❑ Disconnect and connect the connector with the ignition turned off.
- ❑ Unlock to disconnect

4 - Motronic Engine Control Module - J220-

- ❑ Component location: inside the plenum chamber
- ❑ Replacing. Refer to ➤ ["4 Removal and Installation", page 216](#) .

5 - Connecting Piece, 40-Pin

- ❑ Disconnect and connect the connector with the ignition turned off.
- ❑ Unlock to disconnect

6 - Secondary Air Injection Solenoid Valve - N112-

- ❑ For the secondary air injection system
- ❑ Checking. Refer to ➤ ["3.1 Secondary Air Injection Solenoid Valve N112, Checking", page 245](#) .

7 - Engine Coolant Temperature Sensor - G62-

- ❑ If necessary, release the pressure in coolant system before removing.

8 - EVAP Canister Purge Regulator Valve 1 - N80-

- ❑ Installed position: the arrow points in the flow direction

9 - Ignition Coils with Power Output Stage - N70, N127, N291, N292, N323-

- ❑ Removing and installing. Refer to ➤ ["4.1 Ignition Coils with Power Output Stages", page 257](#) .

10 - Mass Airflow Sensor - G70- with Intake Air Temperature Sensor - G42-

- ❑ From MY 2009, the Mass Airflow Sensor - G70- is omitted and the Intake Air Temperature Sensor - G42- is integrated with the Manifold Absolute Pressure Sensor - G71- on the intake manifold.

11 - E-Box Inside Engine Compartment on Left Side

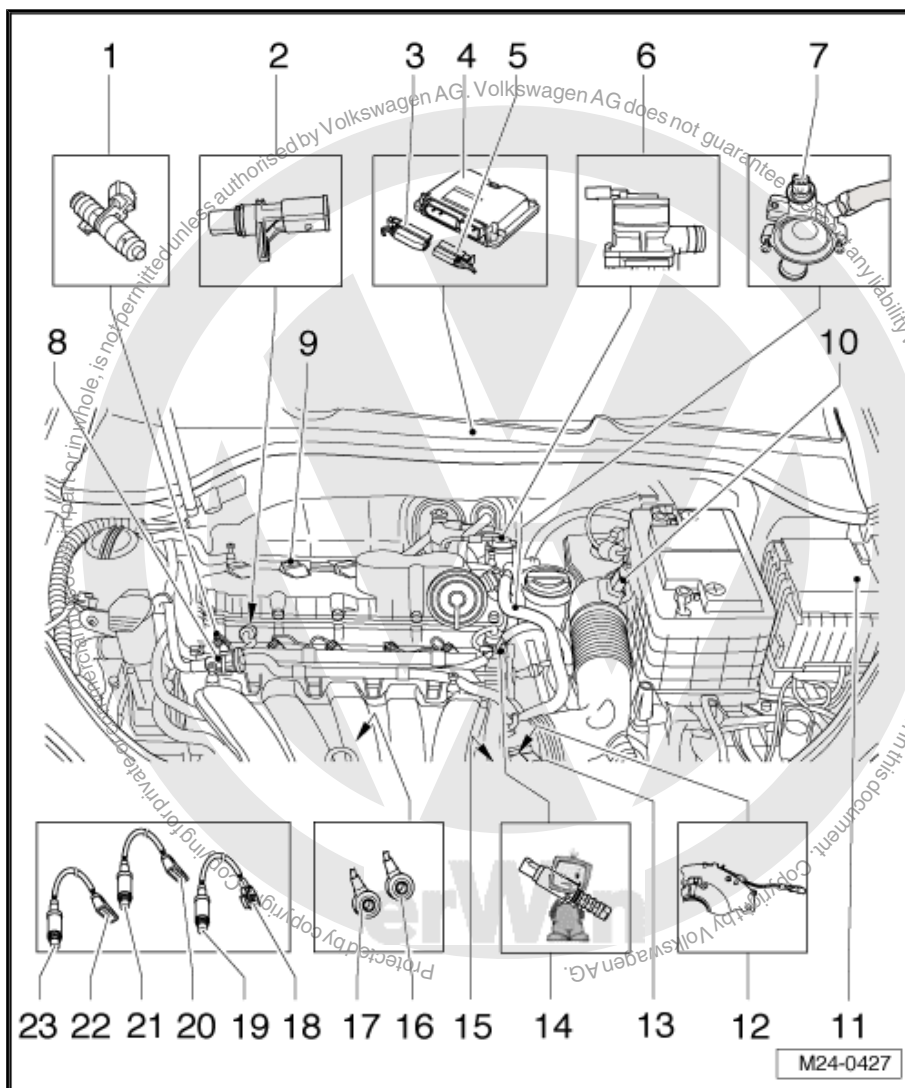
- ❑ Relay and fuse locations. Refer to ➤ Wiring diagrams, Troubleshooting & Component locations

12 - Engine Speed Sensor - G28-

- ❑ Secured to control housing cover

13 - Throttle Valve Control Module - J338-

- ❑ Removing and installing. Refer to ➤ ["4.2 Throttle Valve Control Module J338", page 216](#) .





14 - Camshaft Adjustment Valve 1 - N205-

15 - Secondary Air Injection Pump Motor - V101-

- ❑ Removing and installing: Refer to
⇒ [“4.4 Secondary Air Injection Pump Motor V101 , Removing and Installing”, page 249 .](#)

16 - Knock Sensor 1 - G61-

- ❑ Component location ⇒ [“2.1.3 Overview - Rear Engine”, page 25 .](#)

17 - Knock Sensor 2 - G66-

- ❑ Component location ⇒ [“2.1.3 Overview - Rear Engine”, page 25 .](#)

18 - Connector

- ◆ Engine Codes BGP, BGQ, BTK, CBTA and CBUA: 6-pin
- ◆ Engine code CCCA: 4-pin
 - ❑ Contacts gold plated
 - ❑ Black
 - ❑ For Heated Oxygen Sensor - G39- before catalytic converter and Oxygen Sensor Heater - Z19-
 - ❑ Component location: on the left side of the bulkhead

19 - Heated Oxygen Sensor - G39- Before Catalytic Converter

- ❑ 55 Nm
- ❑ Component location: inside the exhaust manifold
- ❑ Only grease the threads with Hot Bolt Paste - G 052 118 A3- ; the Hot Bolt Paste - G 052 118 A3- must not enter the slits on the sensor body

20 - 4-Pin Connector

- ❑ Engine Codes BGQ and CBUA only
- ❑ Contacts gold plated
- ❑ Black
- ❑ For Heated Oxygen Sensor - G465- and Heater for Oxygen Sensor Center Catalytic Converter - Z59-
- ❑ Component location
⇒ [“4.1 Front Exhaust Pipe with Catalytic Converter, Removing and Installing”, page 246 .](#)

21 - Oxygen Sensor in Bank 1 Center Three Way Catalytic Converter - Z59- , 55 Nm

- ❑ Engine Codes BGQ and CBUA only
- ❑ Component location: inside the center catalytic converter
- ❑ Only grease the threads with Hot Bolt Paste - G 052 118 A3- ; the Hot Bolt Paste - G 052 118 A3- must not enter the slits on the sensor body

22 - 4-Pin Connector

- ❑ Contacts gold plated
- ❑ Brown
- ❑ For Oxygen Sensor after Three Way Catalytic Converter - G130- and Heater for Oxygen Sensor 1 after Catalytic Converter - Z29-
- ❑ Component location
⇒ [“4.1 Front Exhaust Pipe with Catalytic Converter, Removing and Installing”, page 246 .](#)

23 - Oxygen Sensor after Three Way Catalytic Converter - G130-

- ❑ 55 Nm
- ❑ Component location: inside the rear catalytic converter
- ❑ Only grease the threads with Hot Bolt Paste - G 052 118 A3- ; the Hot Bolt Paste - G 052 118 A3- must not enter the slits on the sensor body



2.2 Overview - Intake Manifold with Attachments

1 - Bleeder Hose for Crank-case Ventilation

- ☐ From the cylinder head cover

2 - Ventilation Hose

3 - EVAP Canister Purge Regulator Valve 1 - N80-

4 - Vacuum Hose

- ☐ From the Leak Detection Pump - V144-

5 - Bolt

- ☐ 9 Nm

6 - Fuel Rail

- ☐ Overview. Refer to
⇒ ["2.5 Overview - Fuel Rail with Fuel Injectors"](#),
page 205.

7 - Fuel Supply Line

8 - Seal

- ☐ Replace
- ☐ Note installation position:

Casting mark points upward.

9 Intake Manifold

- ☐ Removing and installing. Refer to
⇒ ["4.3 Intake Manifold"](#),
page 218 .

10 - Rubber Bushing

11 - Intake Manifold Support

12 - Bolt

- ☐ 25 Nm

13 - Bolt

- ☐ 20 Nm

14 - O-Ring

- ☐ No replacement part, part of the Manifold Absolute Pressure Sensor - G71-

15 - Manifold Absolute Pressure Sensor - G71-

16 - Bolt

- ☐ 3.5 Nm

17 - Coolant Connections

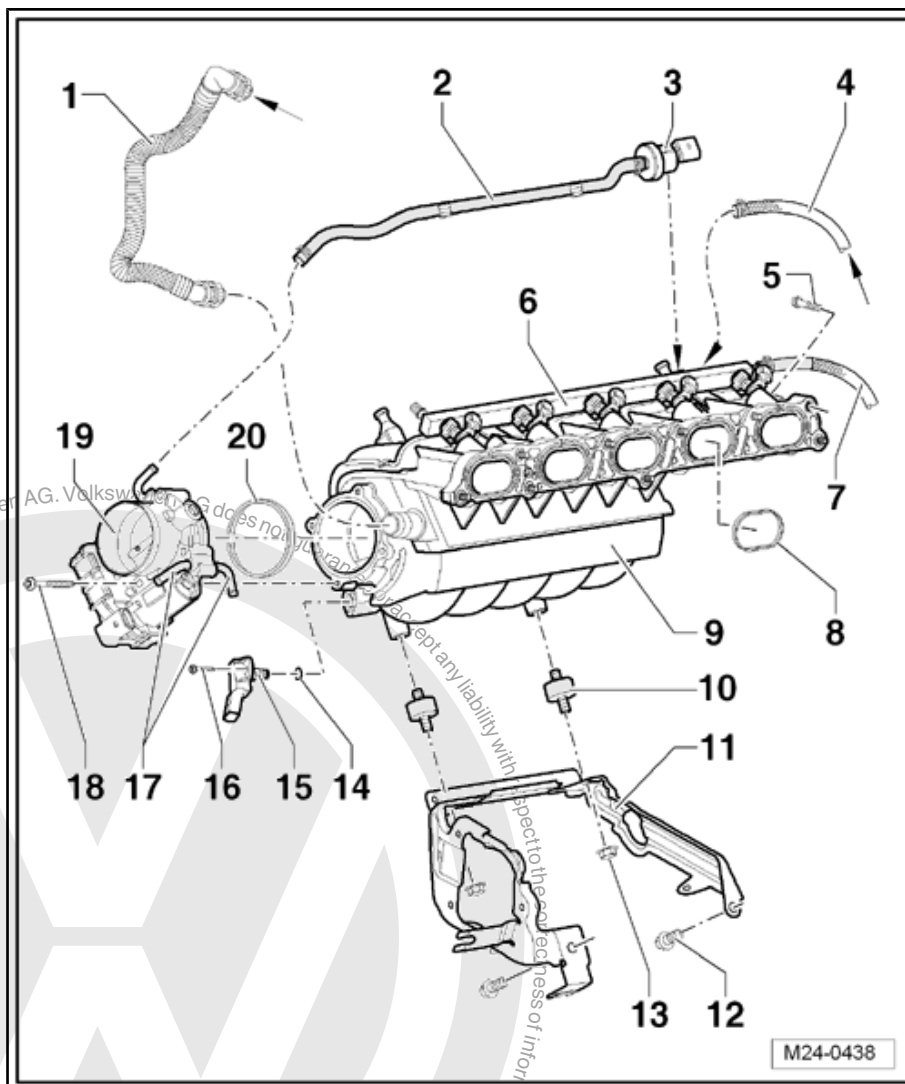
- ☐ Running change: throttle valve control module without coolant heating

18 - Bolt

- ☐ 6.5 Nm

19 - Throttle Valve Control Module - J338-

- ☐ With EPC Throttle Drive - G186- , EPC Throttle Drive Angle Sensor 1 - G187- and EPC Throttle Drive Angle Sensor 2 - G188-





- ☐ When replacing, erase the adaptation values and adapt the engine control module to the throttle valve control module using the Vehicle Diagnostic Tester in "Guided Functions".

20 - Seal

- ☐ Replace if damaged

2.3 Overview - Intake Manifold with Attachments

1 - Bleeder Hose for Crank-case Ventilation

- ☐ From the cylinder head cover

2 - Ventilation Hose

3 - EVAP Canister Purge Regulator Valve 1 - N80-

4 - Vacuum Hose

- ☐ From the Leak Detection Pump - V144-
- ☐ Vehicle through MY 09 only
- ☐ On vehicles from MY 2010, the vacuum connection on the intake manifold is sealed with a cap (new vacuum connection on the vacuum pump/brake booster vacuum line)

5 - Bolt

- ☐ 9 Nm

6 - Fuel Rail

- ☐ Overview. Refer to [⇒ "2.5 Overview - Fuel Rail with Fuel Injectors", page 205](#).

7 - Fuel Supply Line

8 - Seal

- ☐ Replace
- ☐ Note installation position:

Casting mark points upward.

9 - Intake Manifold

- ☐ Removing and installing. Refer to [⇒ "4.3 Intake Manifold", page 218](#).

10 - Intake Manifold Support

11 - Bolt

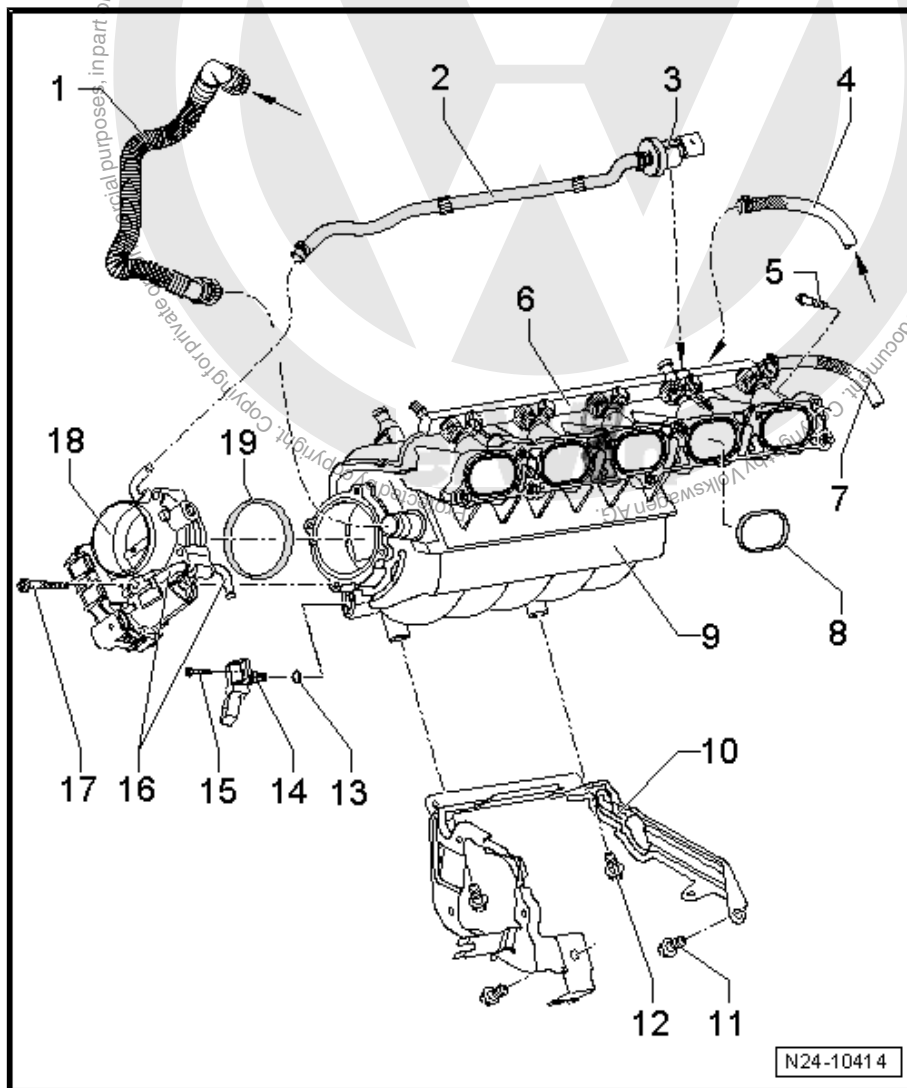
- ☐ 25 Nm

12 - Bolt

- ☐ 16 Nm

13 - O-Ring

- ☐ No replacement part, part of the Manifold Absolute Pressure Sensor - G71-





14 - Manifold Absolute Pressure Sensor - G71-

- ☐ From MY 2009 with Intake Air Temperature Sensor - G42-

15 - Bolt

- ☐ 3.5 Nm

16 - Coolant Connections

- ☐ Running change: throttle valve control module without coolant heating

17 - Bolt

- ☐ 6.5 Nm

18 - Throttle Valve Control Module - J338-

- ☐ With EPC Throttle Drive - G186- , EPC Throttle Drive Angle Sensor 1 - G187- and EPC Throttle Drive Angle Sensor 2 - G188-
- ☐ When replacing, erase the adaptation values and adapt the engine control module to the throttle valve control module using the Vehicle Diagnostic Tester in "Guided Functions".

19 - Seal

- ☐ Replace if damaged

2.4 Overview - Intake Manifold with Attachments

1 - Vent Hose for Crankcase Ventilation

- ☐ From the cylinder head cover

2 - Ventilation Hose

3 - EVAP Canister Purge Regulator Valve 1 - N80-

4 - Fuel Rail

- ☐ Overview. Refer to
⇒ ["2.5 Overview - Fuel Rail with Fuel Injectors"](#),
[page 205](#) .

5 - Bolt

- ☐ 9 Nm

6 - Fuel Supply Line

7 - Seal

- ☐ Replace
- ☐ Note installation position:

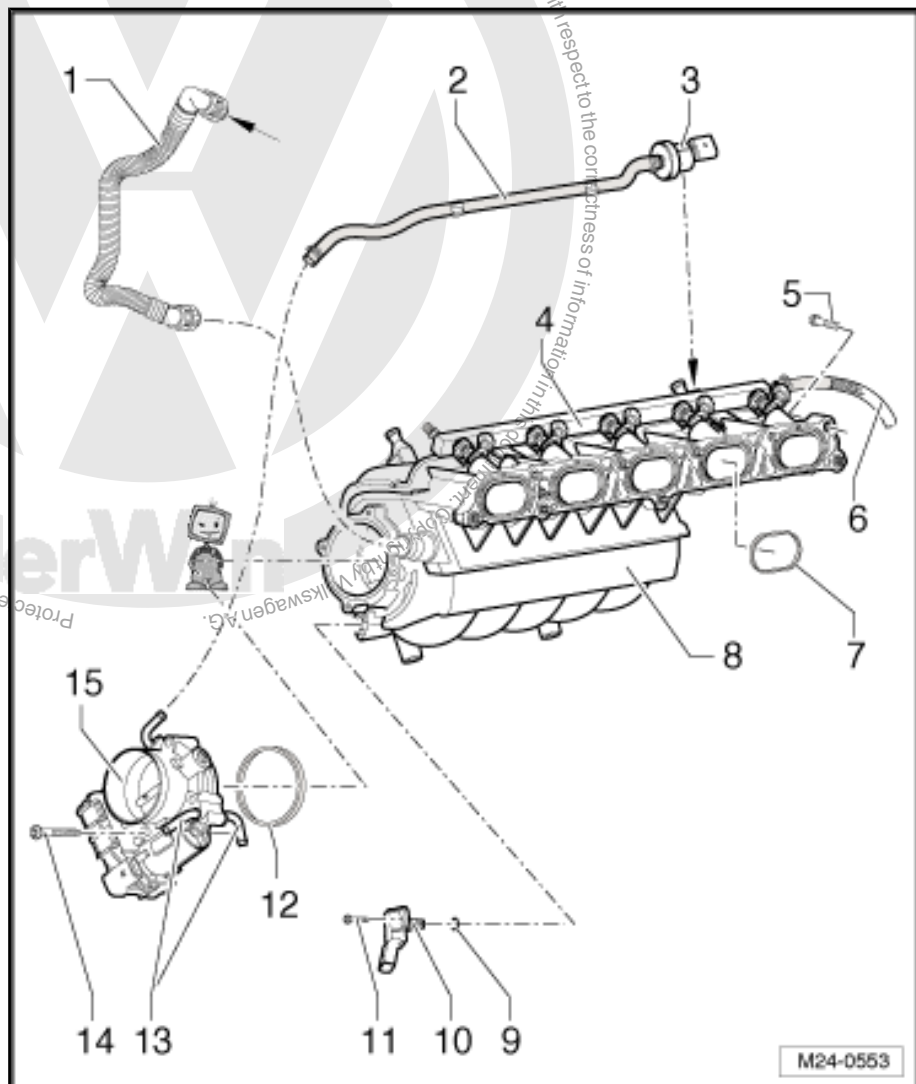
Casting mark points upward.

8 - Intake Manifold

- ☐ Removing and installing. Refer to
⇒ ["4.3 Intake Manifold"](#),
[page 218](#) .

9 - O-Ring

- ☐ No replacement part, part of the Manifold Absolute Pressure Sensor - G71-





10 - Manifold Absolute Pressure Sensor - G71-

- ☐ Not installed in engine code CCCA, the opening is closed

11 - Bolt

- ☐ 3.5 Nm

12 - Seal

- ☐ Replace if damaged

13 - Coolant Connections

- ☐ Only for the coolant reservoir Throttle Valve Control Module - J338-

14 - Bolt

- ☐ 6.5 Nm

15 - Throttle Valve Control Module - J338-

- ☐ With EPC Throttle Drive - G186- , EPC Throttle Drive Angle Sensor 1 - G187- and EPC Throttle Drive Angle Sensor 2 - G188-
- ☒ When replacing, erase the adaptation values and adapt the engine control module to the throttle valve control module using the Vehicle Diagnostic Tester in "Guided Functions".

2.5 Overview - Fuel Rail with Fuel Injectors

1 - Bolt

- ☐ 3.5 Nm

2 - Fuel Rail

3 - Fuel Supply Line

4 - O-Ring

- ☐ Replace
- ☐ Coat with clean engine oil

5 - Clip

- ☐ Make sure clip is correctly seated on fuel injector and fuel distributor

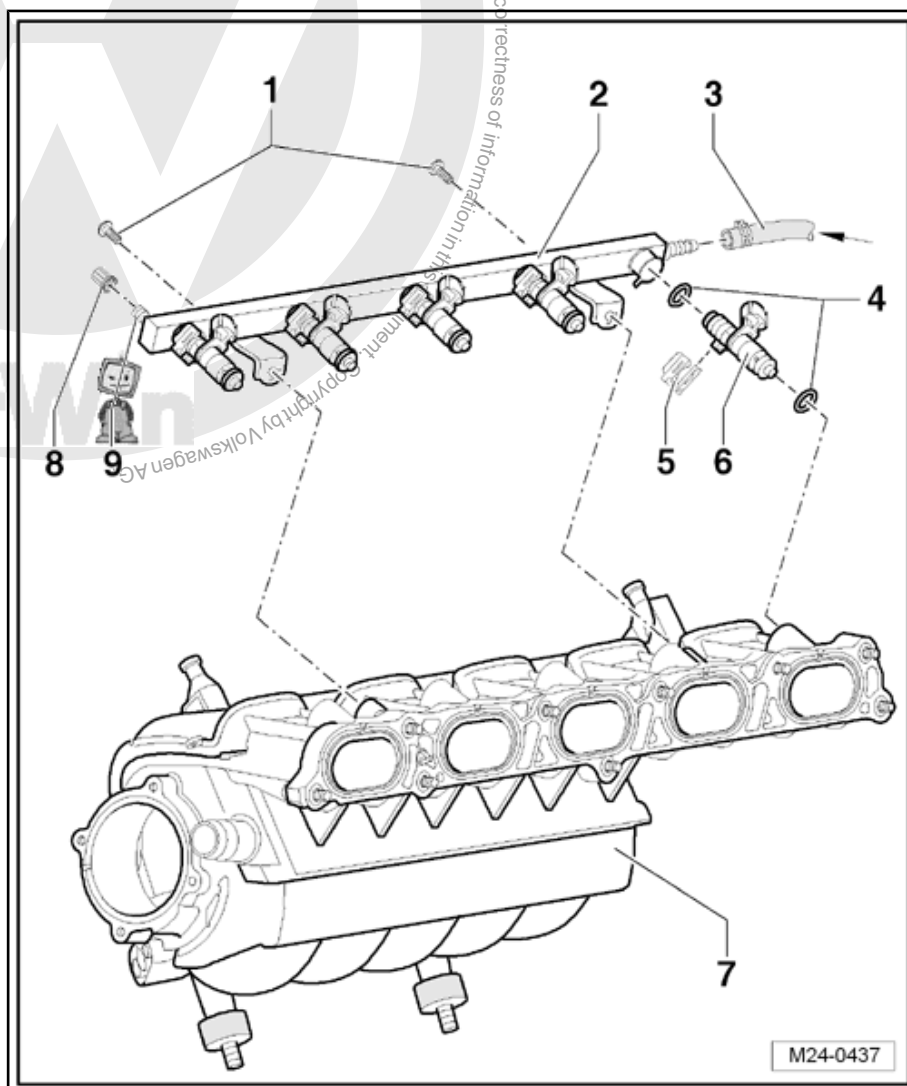
6 - Cylinder 1 through 5 Fuel Injectors - N30, N31, N32, N33 and N83-

- ☐ Removing and installing. Refer to [⇒ "4.4 Fuel Injectors, Removing and Installing", page 221](#) .
- ☐ Checking. Refer to [⇒ "3.1 Fuel Injectors, Checking Injection Quantity and for Leaks", page 208](#) .

7 - Intake Manifold

8 - Protective Cap

9 - Bleeder Valve



M24-0437



2.6 Overview - Air Filter

The air filter upper section also serves as the engine cover.

Engine Cover with Air Filter, Removing and Installing. Refer to
⇒ ["4.1 Engine Cover with Air Filter", page 216](#) .

1 - To the Throttle Valve Control Module - J338-

2 - Spring Clamp

3 - Connection

- ❑ For the ventilation hose to the oil filter bracket

4 - Connection

- ❑ For the secondary air pump suction hose

5 - Intake Hose

- ❑ To the throttle valve control module

6 - Mass Airflow Sensor - G70- with Intake Air Temperature Sensor - G42-

- ❑ With O-ring, replace the O-ring
- ❑ From MY 2009, the Mass Airflow Sensor - G70- is omitted and the Intake Air Temperature Sensor - G42- is integrated with the Manifold Absolute Pressure Sensor - G71- on the intake manifold.

7 - Bolt

- ❑ 3 Nm

8 - From the Air Guide on the Lock Carrier

9 - Bolt

- ❑ 1.5 Nm

10 - Intake Hose

- ❑ To air filter

11 - Air Filter Upper Section

12 - Rubber Bushing

- ❑ Do not use lubricant

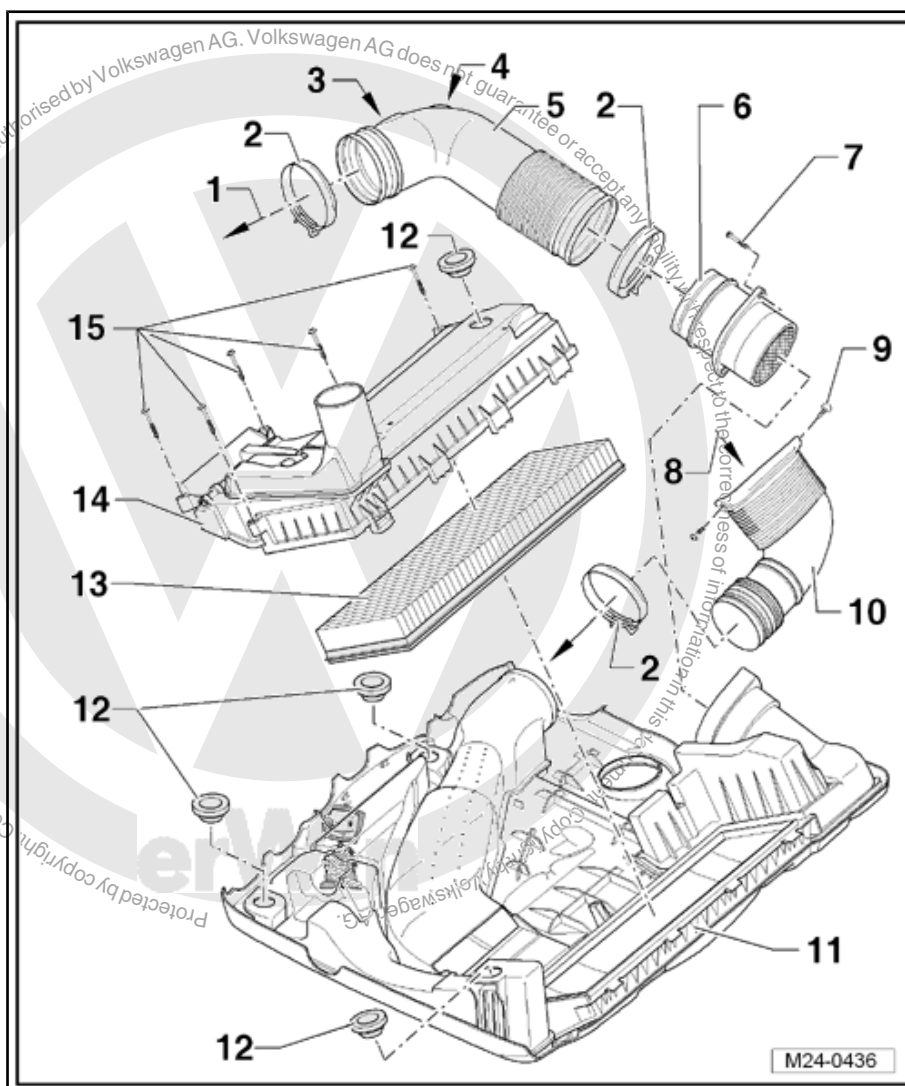
13 - Filter

14 - Air Filter Lower Section

- ❑ On engine codes CBTA, CBUA and CCCA the warm air intake is discontinued

15 - Bolt

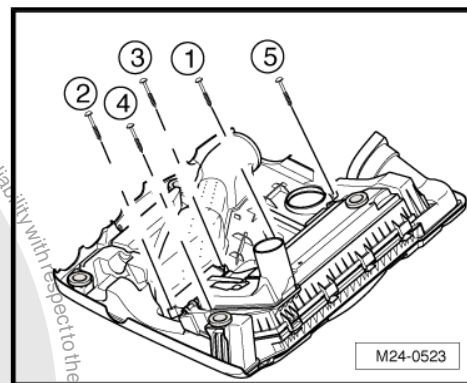
- ❑ 2 Nm
- ❑ Observe the tightening sequence. Refer to
⇒ [Fig. "Tightening sequence for the air filter lower section", page 207](#) .





Tightening sequence for the air filter lower section

- Tighten the bolts to 2 Nm in the following sequence: -1 to 5-





3 Diagnosis and Testing

⇒ [“3.1 Fuel Injectors, Checking Injection Quantity and for Leaks”, page 208](#)

⇒ [“3.2 Fuel Pressure Regulator and Residual Pressure, Checking”, page 211](#)

⇒ [“3.3 Engine Control Module DTC Memory, Checking and Erasing”, page 214](#)

3.1 Fuel Injectors, Checking Injection Quantity and for Leaks

Special tools and workshop equipment required

- ◆ Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A-
- ◆ Injection Rate Comparison Meter Kit - Adapter - VAG1348/3-2-
- ◆ Injection Rate Tester - VAG1602-
- ◆ Connector Test Set - VAG1594D-
- ◆ Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565-

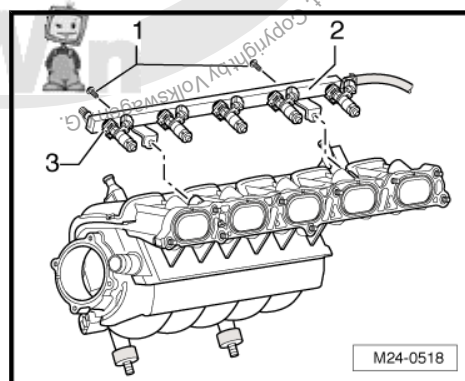


Note

- ◆ *Follow all Safety Precautions. Refer to ⇒ [“1.2 Safety Precautions”, page 197](#).*
- ◆ *Follow all the rules of cleanliness. Refer to ⇒ [“1.3 Clean Working Conditions”, page 197](#).*

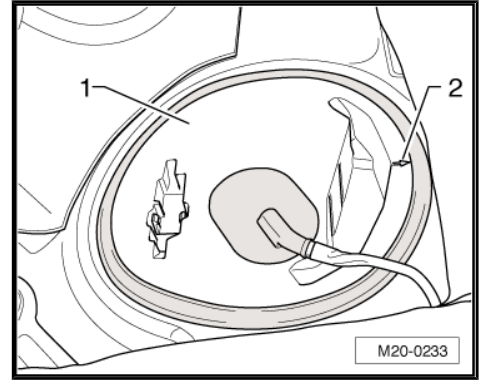
Checking for leaks

- The fuel pressure must be OK. Refer to ⇒ [“3.2 Fuel Pressure Regulator and Residual Pressure, Checking”, page 211](#).
- Remove fuel rail -2- with fuel injectors installed and place it on a clean rag. Refer to ⇒ [“4.4 Fuel Injectors, Removing and Installing”, page 221](#).
Do not disconnect battery and do not disconnect fuel supply line at quick acting coupling or at fuel rail.
- Harness connectors must be disconnected from fuel injectors.
- Remove the bench seat. Refer to ⇒ Body Interior; Rep. Gr. 72 ; Rear Seats; Bench Seat, Removing and Installing .

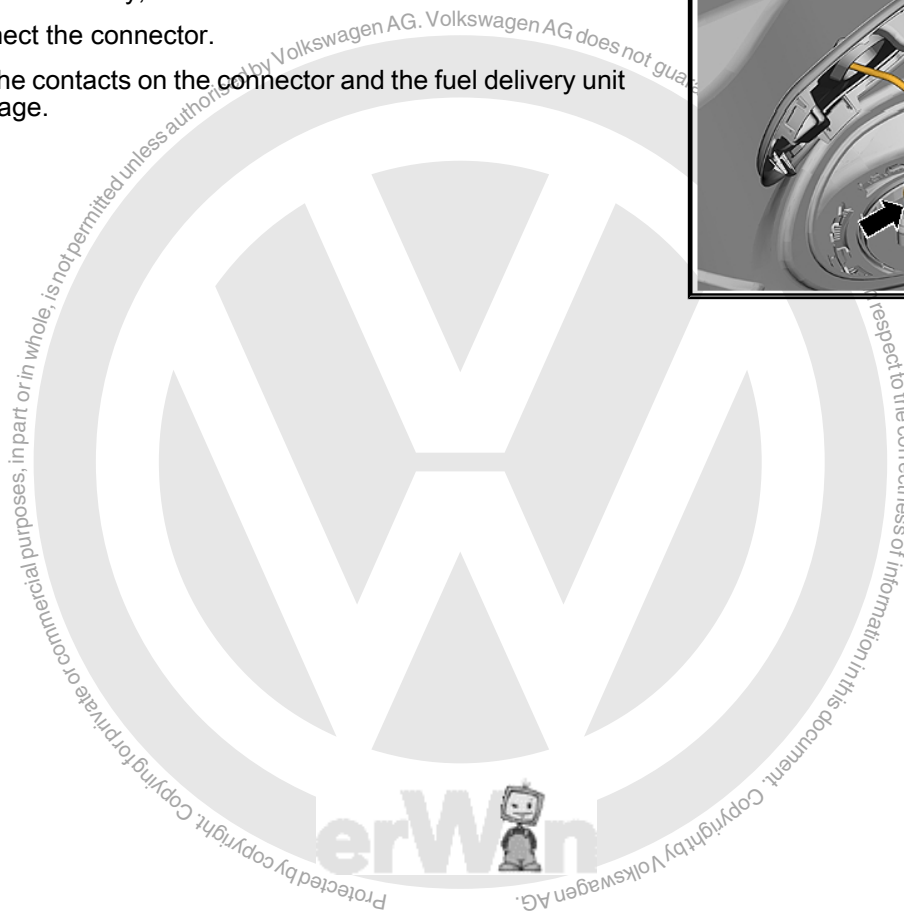
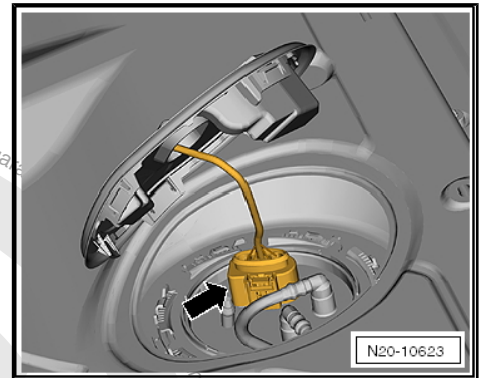




- Unclip the cover -1- from the fuel delivery unit. The arrow -2- points in direction of travel.



- Pull on the connector -arrow- without pressing the retainer to make sure it is connected securely. If the connector was not connected correctly, it could cause a fault.
- Disconnect the connector.
- Check the contacts on the connector and the fuel delivery unit for damage.





- Attach the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- to the connecting piece and to the fuel delivery unit.
- Connect the Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A- to the Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565- and battery positive (+).
- Operate the Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A- .



Note

This work step allows the fuel pump to run when the engine is not running.

- Check injectors for leaks (visual inspection).
- Only 1 to 2 drops per minute may emit from each valve when fuel pump is running.

If the fuel loss is greater:

- Disconnect connection to battery plus (+) and replace leaking fuel injector. Refer to
⇒ [“4.4 Fuel Injectors, Removing and Installing”, page 221](#) .

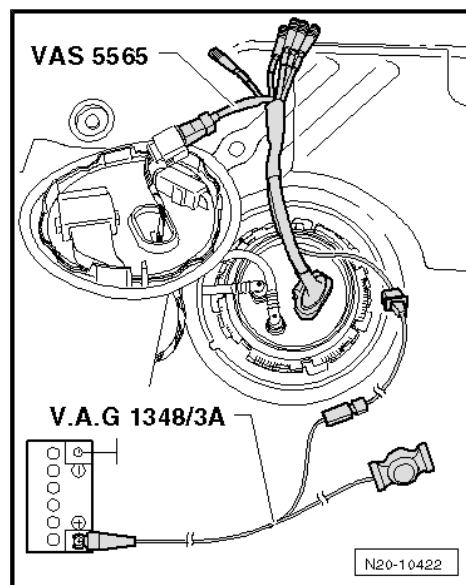


Note

- ◆ *If fuel injectors are replaced, erase adaptation values and adapt the engine control module again using the Vehicle Diagnostic Tester in “Guided Functions”.*
- ◆ *Always use new seals.*

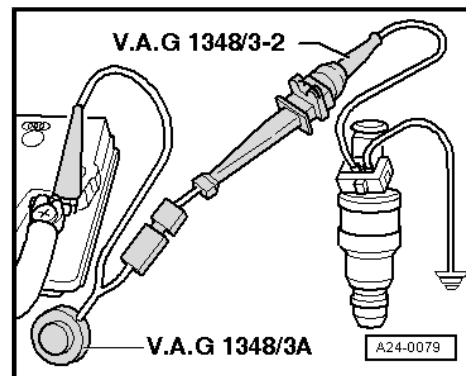
Injection Quantity, Checking

- The fuel pressure must be OK. Refer to
⇒ [“3.2 Fuel Pressure Regulator and Residual Pressure, Checking”, page 211](#) .
- Fuel rail removed.
- Fuel injectors installed in fuel rail and fuel line connected.
- Fuel pump runs (connected to battery with adapter cables).
- Insert the fuel injector to be checked into a measuring glass from the Injection Rate Tester - VAG1602- .





- Using the adapter cables from the Connector Test Set - VAG1594D- , connect one contact of the fuel injector to be checked to engine ground.
- Connect the second terminal of the fuel injector to the Injection Rate Comparison Meter Kit - Remote Cable -VAG1348/3 A- using the Injection Rate Comparison Meter Kit - Adapter - VAG1348/3-2- .
- Connect the alligator clip to the battery positive (+) .
- Operate the Injection Rate Comparison Meter Kit - Remote Cable -VAG1348/3A- for 30 seconds.
- Repeat the check for the other injectors. Use new graduated measuring glasses for this.
- After all fuel injectors have been activated, place graduated measuring glasses on a level surface and compare quantity of injected fuel.
- Specified value: 85 to 105 ml per valve



While checking the injection quantity, the spray pattern should also be checked. Spray pattern must be the same for all fuel injectors.

If the measured value of one or more fuel injectors is below or above the indicated specified value:

- Replace faulty fuel injector
 ⇒ ["4.4 Fuel Injectors, Removing and Installing", page 221](#) .

3.2 Fuel Pressure Regulator and Residual Pressure, Checking

Special tools and workshop equipment required

- ◆ Pressure Tester Kit - VAS6550-



Note

- ◆ Follow all Safety Precautions. Refer to
 ⇒ ["1.2 Safety Precautions", page 197](#) .
- ◆ Follow all the rules of cleanliness. Refer to
 ⇒ ["1.3 Clean Working Conditions", page 197](#) .
- Check the functionality of the fuel pump. Refer to
 ⇒ ["3.1.1 Function and Power Supply, Checking", page 155](#) .



Note

- ◆ The fuel pressure regulator regulates the fuel pressure to approximately 4 bar.
- ◆ Fuel pressure regulator is located on fuel filter. From 10/2005, the fuel pressure regulator is integrated into the fuel filter and cannot be replaced separately.
- ◆ Follow all Safety Precautions. Refer to
 ⇒ ["1.2 Safety Precautions", page 197](#) .
- ◆ Follow all the rules of cleanliness. Refer to
 ⇒ ["1.3 Clean Working Conditions", page 197](#) .

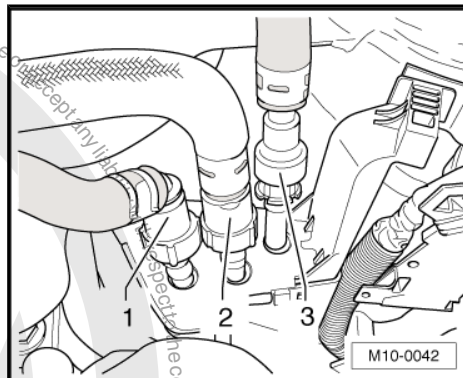


WARNING

Fuel system is under pressure!

- ◆ ***Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.***
- ◆ ***Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.***

- Disconnect the fuel supply line -3-. Press the circlip upward into the housing to release the line -3-.





- Connect the Pressure Tester Kit - VAS6550- to the fuel supply line using the Pressure Tester Kit - Hose 1 - VAS6550/1- and Pressure Tester Kit - Hose 2 -VAS6550/2- .
- Make sure the drain is closed and the shut-off valves are open.
- Start engine and run at idle speed.



Note

If the engine does not start, activate the fuel pump with output diagnostic test mode.

- Check the fuel pressure on the pressure gauge.
 - Specified value: 3.8 to 4.2 bar

If the fuel pressure is OK, check the residual pressure. Refer to ➤ [page 213](#) .

If the specification is exceeded:

- Check the fuel return line between the fuel filter and the flange for possible restrictions (kinks) or blockages.

If no malfunction can be found:

- The fuel pressure regulator is faulty. Replace it.

If the specification is not obtained:

- Check the fuel lines for possible restrictions (kinks) or blockages.

If no malfunction can be found:

- Replace the fuel pressure regulator.



Note

From 10/2005, the fuel pressure regulator is integrated into the fuel filter and cannot be replaced separately.

- Repeat the test.

If specified value is again not obtained:

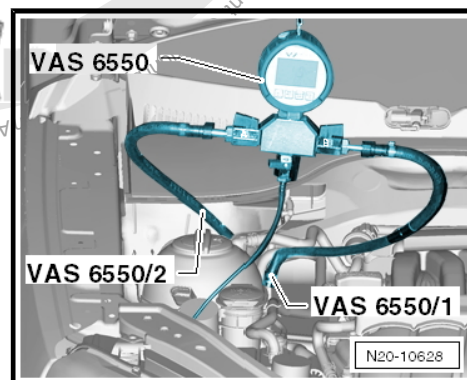
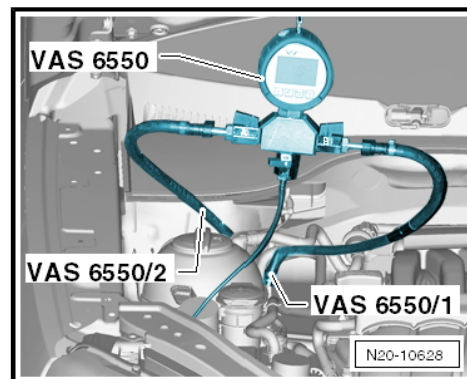
- Replace the fuel delivery unit if the fuel pump is faulty. Refer to ➤ ["4.2 Fuel Delivery Unit", page 177](#) .

If the specified value is reached, check the residual pressure as follows:

- Watch the pressure decrease on the pressure gauge.
 - After 10 minutes the pressure must not drop below a 3.0 bar.

If the pressure drops further:

- Start engine and run at idle speed.





- Switch the ignition off and close the pressure gauge shut-off valve -B- immediately.

If pressure no longer drops now:

Check for the leak on the engine side. Repeat the residual pressure check. Close the shut-off valve -A- this time to determine if there actually is a leak on the engine side.

- Check the fuel rail and fuel injectors for leaks.

If the pressure drops again:

(Leak on fuel tank side)

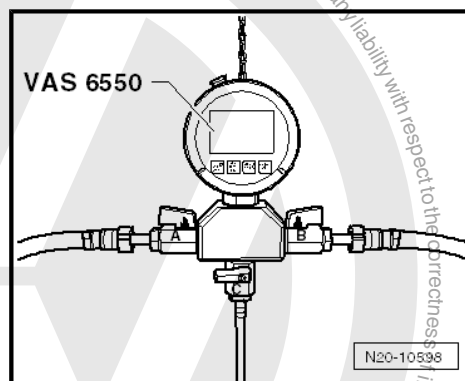
- Check the fuel lines for leaks.

If no malfunctions are found in the fuel lines:

- Check the fuel pump check valve. Refer to
⇒ [“3.1.4 Fuel Pump Check Valve, Checking”, page 161](#) .

If no malfunction is found here either:

- Replace the fuel pressure regulator. Refer to -item 5-
⇒ [Item 5 \(page 147\)](#) .



Note

From 10/2005, the fuel pressure regulator is integrated into the fuel filter and cannot be replaced separately.

- Bleed the fuel system. Refer to
⇒ [“4.6 Fuel System, Bleeding”, page 184](#) .

3.3 Engine Control Module DTC Memory, Checking and Erasing

Special tools and workshop equipment required

- ◆ Vehicle Diagnostic Tester

Connect the Vehicle Diagnostic Tester as follows:

- Connect the diagnostic cable connector -2- to the diagnostic connection inside the driver footwell.
- Start engine and run at idle speed.

Only if engine does not start:

- Switch the ignition on.

Selecting operating mode:

- Press button on display for “Vehicle On Board Diagnostic (OBD)”.

Selecting vehicle system:

- Press button “01 - Engine electronics” on display.




The control module identification with coding -2- as well as Vehicle Identification Number (VIN) in center area and identification of anti-theft immobilizer appear on the display.



Note

A print-out is available. Press the "print" button if required.

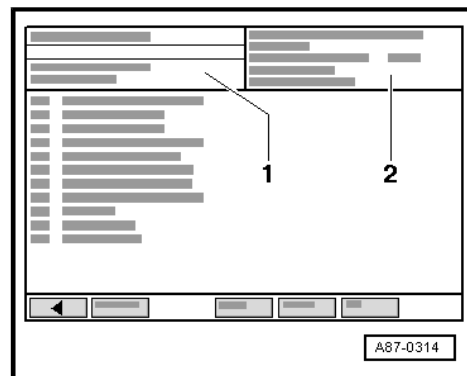
Selecting diagnosis function:

- Press button "02 - Check DTC memory" on display.
- If no malfunction is stored in engine control module, "0 DTC(s) detected" is displayed.
- If malfunctions are stored in the engine control module, these are shown one below another on the display.
- Press the  button.
- Press button "05 - Erase DTC memory" on display.
- Touch the "06 - End output" function.



Note

If the DTC memory was erased, the readiness code must be re-generated using the Vehicle Diagnostic Tester in "Guided Fault Finding".





4 Removal and Installation

⇒ [“4.1 Engine Cover with Air Filter”, page 216](#)

⇒ [“4.3 Intake Manifold”, page 218](#)

⇒ [“4.2 Throttle Valve Control Module J338 ”, page 216](#)

⇒ [“4.4 Fuel Injectors, Removing and Installing”, page 221](#)

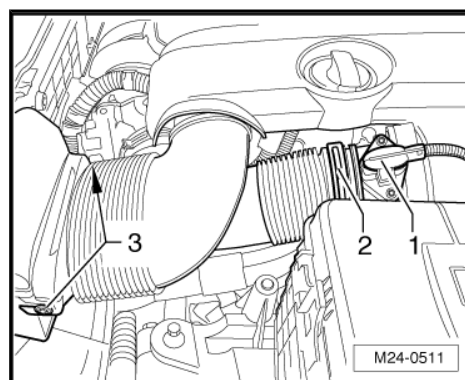
⇒ [“4.5 Engine Control Module, through 10/2008”, page 223](#)

⇒ [“4.6 Engine Control Module, from 11/2008”, page 227](#)

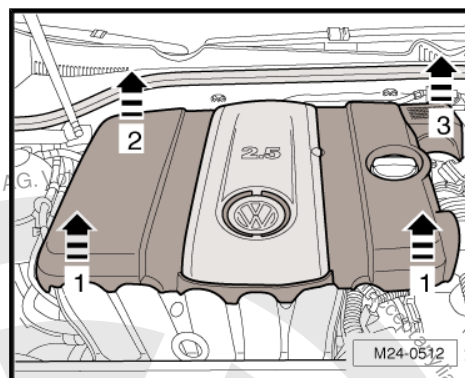
4.1 Engine Cover with Air Filter

Removing

- Disconnect the connector -1- and the intake hose -2-.
- Remove the bolts -3- and the pull off the intake hose.



- Pull the engine with a jerk out of the mounts first at the front -arrow 1-, then at the right rear -arrow 2- and finally at the left rear -arrow 3-.
- Carefully swivel engine cover out of rear area.



Installing



Note

Rubber bushings -item 12- ⇒ [Item 12 \(page 206\)](#) must not be treated with lubricant, neither for assembly in air filter nor for assembly on engine.

- Position engine cover correctly in mounts and press in by hand.

The rest of the installation follows the reverse of the removal procedures.

4.2 Throttle Valve Control Module - J338-

Special tools and workshop equipment required

- ♦ Hose Clamps - Up To 25mm - 3094 , only for a Throttle Valve Control Module - J338- heated by coolant

Removing

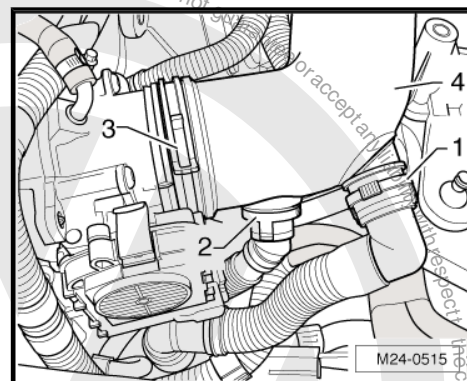


Note

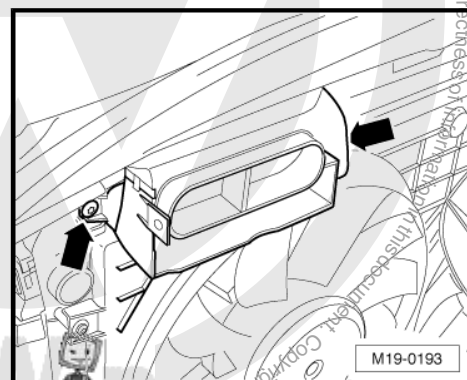
Follow all the rules of cleanliness. Refer to
⇒ [“1.3 Clean Working Conditions”, page 197](#) .



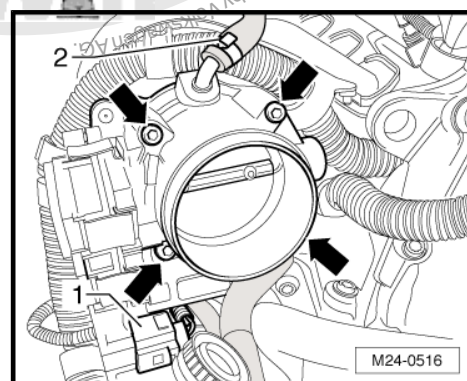
- Remove the engine cover with air filter. Refer to
 ⇒ [“4.1 Engine Cover with Air Filter”, page 216](#) .
- Remove the intake hose -4- between the Throttle Valve Control Module - J338- and the air filter. To do so, disconnect air hose -1-, if present, and air hose -2- (compress securing ring) and remove spring clamp -3-.



- Remove the intake air connection from the lock carrier -arrows-.



- Disconnect the connector -1- and the ventilation hose -2-.
- Remove the bolts -arrows-.



Note

Seal the intake channel in intake manifold using a clean rag.

- Clamp off the coolant hoses with Hose Clamps - Up To 25mm - 3094- and disconnect them from the throttle valve connection -arrows-.

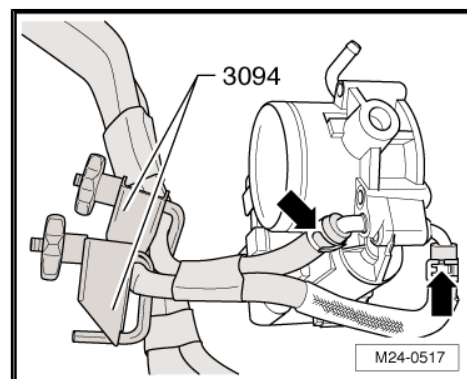


Note

Coolant hoses only for the Throttle Valve Control Module - J338- heated by coolant

Installing

Install in reverse order of removal. Note the following:

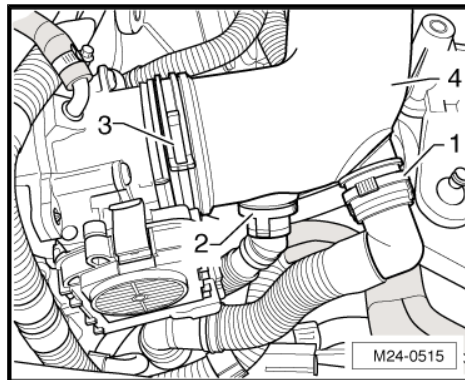




- ◆ Replace sealing ring for throttle valve control module if damaged.
- ◆ Coolant hose connections -item 21- ➔ [Item 21 \(page 117\)](#) .
- ◆ Make sure air hoses -1- and -2- are fitted securely.
- ◆ When replacing, erase the adaptation values and adapt the engine control module to the throttle valve control module using the Vehicle Diagnostic Tester in "Guided Functions".

Tightening specifications:

Component	Nm
Throttle Valve Control Module to intake manifold	6.5



4.3 Intake Manifold

Special tools and workshop equipment required

- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Socket and Extended Bit - T10107A-

Removing



Note

- ◆ *Follow all Safety Precautions. Refer to ➔ ["1.2 Safety Precautions", page 197](#) .*
- ◆ *Follow all the rules of cleanliness. Refer to ➔ ["1.3 Clean Working Conditions", page 197](#) .*
- First, check whether a coded radio is installed. If necessary, obtain the anti-theft coding.
- Disconnect the battery. Refer to ➔ Electrical Equipment; Rep. Gr. 27 ; Battery, Disconnecting and Connecting .
- Remove the engine cover with air filter. Refer to ➔ ["4.1 Engine Cover with Air Filter", page 216](#) .



WARNING

Fuel system is under pressure!

- ◆ *Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.*
- ◆ *Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.*

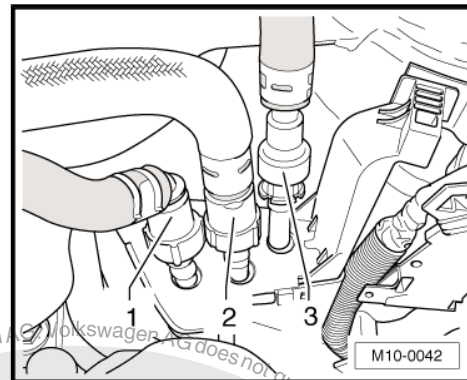


- Disconnect the vacuum line -2- (BGP and BGQ only and CBTA and CBUA through MY 2009), the ventilation line -1- and the fuel supply line -3-.

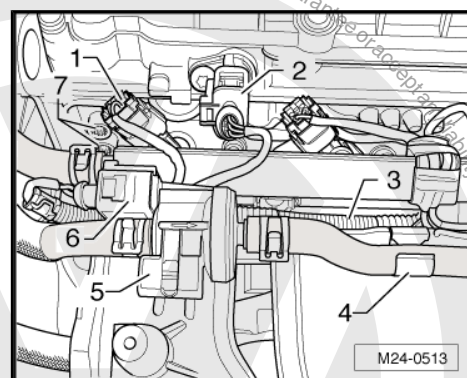
To release wires -1- and -2-, press the circlip in.

Press the circlip upward into the housing to release the line -3-.

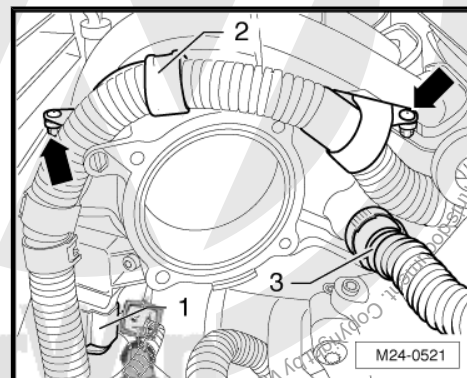
- Seal the lines so that no dirt can enter the fuel system.



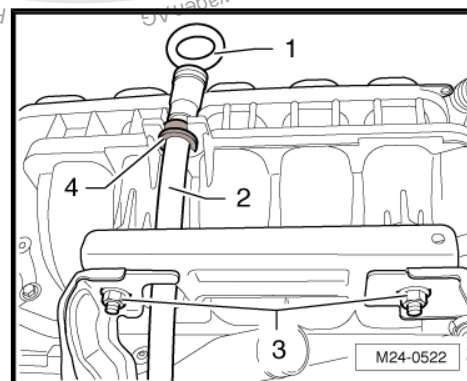
- Disconnect connectors -1-, -2- and -6-.
- Remove the wiring harness -3- from the transport strap.
- Remove the clamps -4- and the retaining ring -5-.
- Remove the bolts -7- and the transport strap.
- Remove the Throttle Valve Control Module - J338- . Refer to ⇒ ["4.2 Throttle Valve Control Module J338", page 216](#) . The coolant hoses remain attached.



- Disconnect the connector -1- and the crankcase housing ventilation hose -3-.
- Remove the wiring harness -2-. Carefully remove the clips -arrows-.

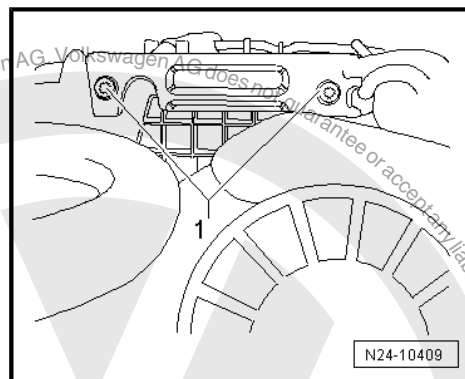


- Remove the oil dipstick -1- and push the retaining ring -4- downward.
- Remove the noise insulation. Refer to ⇒ Body Exterior; Rep. Gr. 50 ; Noise Insulation .

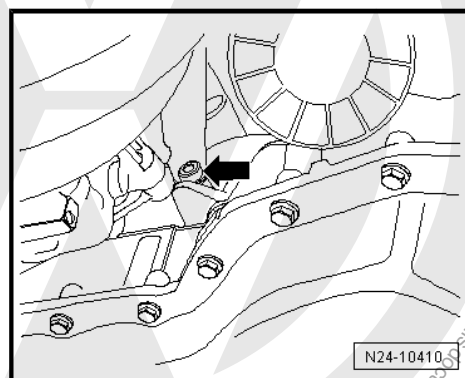




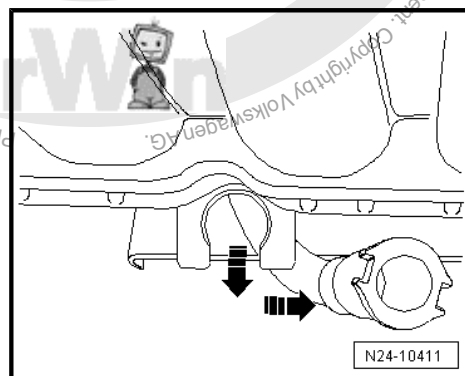
- Loosen the bolts or nuts -1- on the intake manifold lower section.



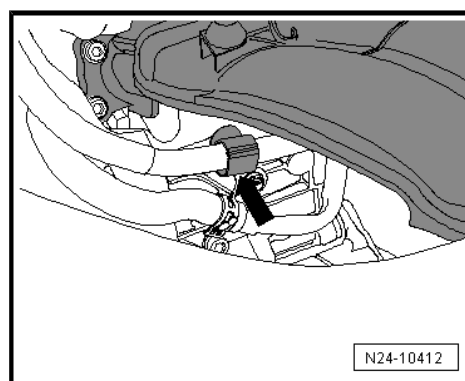
- Loosen the bolt -arrow- on the guide tube.



- Move the guide tube -arrows- to the side.



- Open the clip -arrow- on the Leak Detection Pump - V144- vacuum hose.





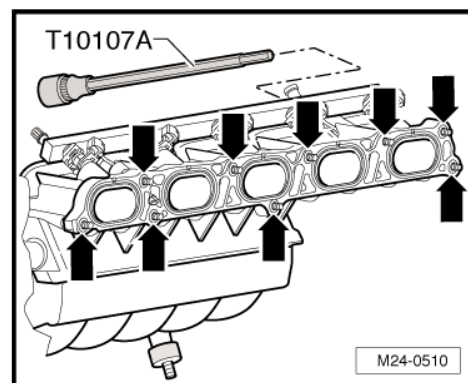
- Remove the intake manifold bolts -arrows- from the cylinder head using the Socket And Extended Bit - T10107A- .

The bolts remain in the intake manifold.

- Remove intake manifold upward at an angle.
 Make sure that no bolts fall out.
- Seal the intake channels in cylinder head using a clean rag.

If manifold must be replaced:

- Remove fuel rail with injectors. Refer to
 ➤ [“4.4 Fuel Injectors, Removing and Installing”, page 221](#) .
- Disconnect vacuum hose for the Leak Detection Pump - V144- .
- Remove the Manifold Absolute Pressure Sensor - G71- .



Installing

Install in reverse order of removal. Note the following:

- ◆ Replace sealing rings between intake manifold and cylinder head.
- ◆ Tighten bolts for intake manifold starting inside working toward outside and in diagonal sequence.
- Connect the battery. Refer to ➤ Electrical Equipment; Rep. Gr. 27 ; Battery, Disconnecting and Connecting .
- Bleed the fuel system. Refer to
 ➤ [“4.6 Fuel System, Bleeding”, page 184](#) .

Tightening specifications:

Component	Nm
Intake manifold to cylinder head	9
Intake manifold support to intake manifold, engine codes BGP and BGQ	20
Intake manifold support to intake manifold, engine codes CBTA and CBUA	16
Intake manifold support to cylinder block	25
Transport strap to cylinder head	25
Oil dip stick guide tube to cylinder block	25
Manifold Absolute Pressure Sensor - G71- on the intake manifold	3.5

4.4 Fuel Injectors, Removing and Installing

Removing



Note

- ◆ Follow all Safety Precautions. Refer to
 ➤ [“1.2 Safety Precautions”, page 197](#) .
- ◆ Follow all the rules of cleanliness. Refer to
 ➤ [“1.3 Clean Working Conditions”, page 197](#) .
- First, check whether a coded radio is installed. If necessary, obtain the anti-theft coding.
- Disconnect the battery. Refer to ➤ Electrical Equipment; Rep. Gr. 27 ; Battery, Disconnecting and Connecting .



- Remove the engine cover with air filter. Refer to
⇒ [“4.1 Engine Cover with Air Filter”, page 216](#) .

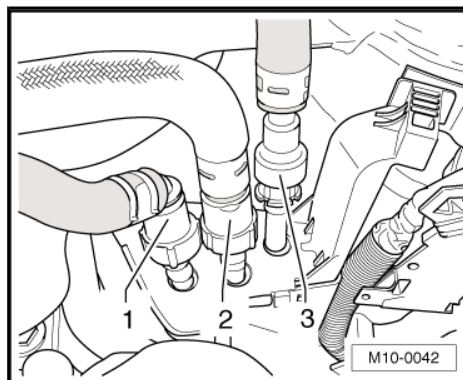


WARNING

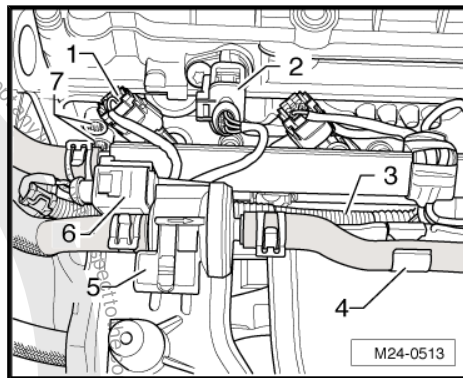
Fuel system is under pressure!

- ◆ **Always wear protective eyewear and protective clothing to prevent injuries and fuel from coming in contact with your skin.**
- ◆ **Wrap a cloth around the wiring connections before loosening hose connections. Then release pressure by carefully pulling off the line.**

- Disconnect the vent line -1- and the fuel supply line -3-. To release wire -1-, press the circlip in. Press the circlip upward into the housing to release the line -3-.
- Seal the lines so that no dirt can enter the fuel system.



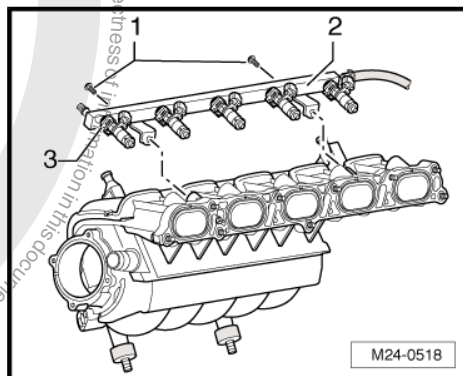
- Disconnect connectors -1-, -2- and -6-.
- Remove the wiring harness -3- from the transport strap.
- Remove the clamps -4- and the retaining ring -5-.
- Remove the bolts -7- and the transport strap.



- Remove the bolts -1- and pull the fuel rail, with the fuel injectors, evenly out of the intake manifold.
- Seal or cover openings in intake manifold.
- Remove the clips -3- and the fuel injectors.

Installing

- Install new O-rings for fuel injectors and coat them lightly with clean engine oil.

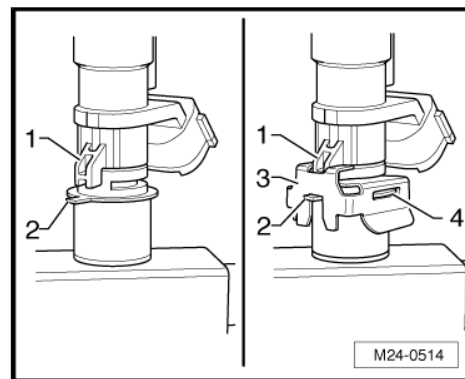




- Install the fuel injectors into the fuel rail so that the tabs -1- and -2- line up with each other.
- Install the clip -3- into the groove on the fuel injector as illustrated. The shoulder -4- must be correctly located in the cutout of the retaining clip on both sides.
- After assembling, check all fuel injectors for correct fitting.
- Attach fuel rail with secured fuel injectors on intake manifold and press it in uniformly.
- Bolt fuel rail to intake manifold.

The rest of the installation follows the reverse of the removal procedures. Note the following:

- Connect the battery. Refer to ➔ Electrical Equipment; Rep. Gr. 27 ; Battery, Disconnecting and Connecting .



Note

If fuel injectors are replaced, erase adaptation values and adapt the engine control module again using the Vehicle Diagnostic Tester in "Guided Functions".

- Bleed the fuel system. Refer to
 ➔ ["4.6 Fuel System, Bleeding", page 184](#) .

Tightening Specification:

Component	Nm
Fuel distributor to intake manifold	3.5

4.5 Engine Control Module, through 10/2008

Without Anti-Theft Immobilizer

➔ ["4.5.1 Engine Control Module", page 223](#)

With anti-theft immobilizer

➔ ["4.5.2 Engine Control Module", page 224](#)

4.5.1 Engine Control Module



Note

If the engine control module will be replaced, connect the vehicle diagnostic tester and perform the "Replacing Engine Control Module" guided function.

Removing

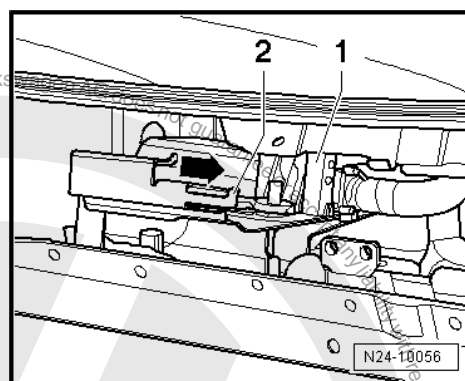
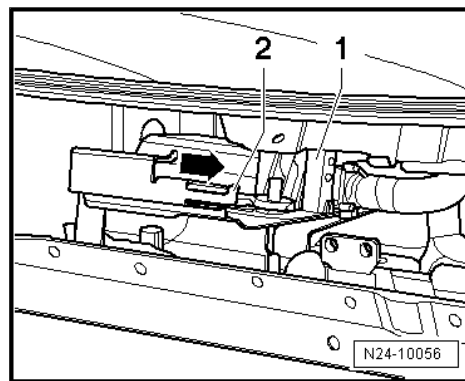
- Switch off the ignition.
- Remove the wiper arms and the plenum chamber cover. Refer to ➔ Electrical Equipment; Rep. Gr. 92 ; Windshield Wiper System; Windshield Wiper System, Removing and Installing .
- Remove the plenum chamber bulkhead. Refer to ➔ Body Exterior; Rep. Gr. 50 ; Plenum Chamber Bulkhead; Plenum Chamber Bulkhead Assembly Overview .



- Disconnect the front connector -1- from the engine control module.
- Pry up locking mechanism -2- slightly.
- Then slide the engine control module out of the retainer -arrow-.
- Now disengage rear harness connector from Engine Control Module (ECM) and disconnect it.

Installing

- Connect the rear harness connector to engine control module and engage it.
- Slide the engine control module onto the retaining plate.
- Push the locking mechanism -2- against the engine control module.
- Connect the front connector -1- to the engine control module.
- Install the plenum chamber bulkhead. Refer to ➤ Body Exterior; Rep. Gr. 50 ; Plenum Chamber Bulkhead; Plenum Chamber Bulkhead - Assembly Overview .
- Install the wiper arms and the plenum chamber cover. Refer to ➤ Electrical Equipment; Rep. Gr. 92 ; Windshield Wiper System; Windshield Wiper System, Removing and Installing .



4.5.2 Engine Control Module

Special tools and workshop equipment required

- ◆ Window Cutter - VAG1561A-
- ◆ Window Cutter - Saw Set - VAG1561/14-
- ◆ Hot air gun from the Wiring Harness Repair Set - VAS1978B- .
- ◆ Attachment nozzle from the Wiring Harness Repair Set - VAS1978B- .
- ◆ Locking pliers



Note

If the engine control module will be replaced, connect the vehicle diagnostic tester and perform the "Replacing Engine Control Module" guided function.

Removing

- Switch off the ignition.
- Remove the wiper arms and the plenum chamber cover. Refer to ➤ Electrical Equipment; Rep. Gr. 92 ; Windshield Wiper System; Windshield Wiper System, Removing and Installing .
- Remove the plenum chamber bulkhead. Refer to ➤ Body Exterior; Rep. Gr. 50 ; Plenum Chamber Bulkhead; Plenum Chamber Bulkhead Assembly Overview .



i Note

Thread of shear bolts is equipped with locking compound. By heating the shear bolts using a hot air gun, inhibition effect of the locking compound is lowered.



Caution

Cover the wires, connectors and control modules near the engine control module to prevent them from being burned.

Perform the adjustments on the hot air gun -4- as shown:

- Turn potentiometer for temperature adjustment -2- to maximum heat output (600 °C (1112 °F)).
- Move two stage switch for air quantity -3- to position 3.

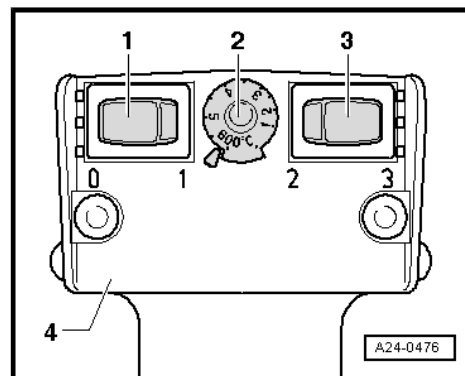


WARNING

By heating the shear bolts, parts of the protective housing are heated intensely. Wear protective gloves to prevent injuries.

- Guide nozzle of hot air gun on to shear bolts.
- Switch on heat gun and heat bolt for approximately 20 to 25 seconds.
- Remove the shear bolt by the bolt head with pliers .

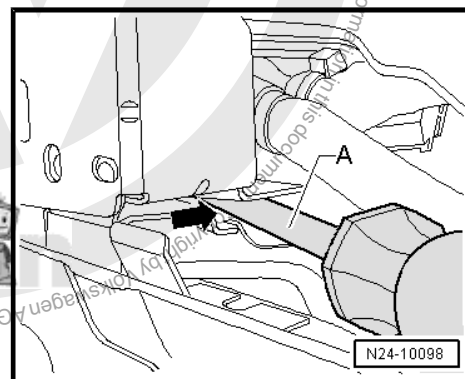
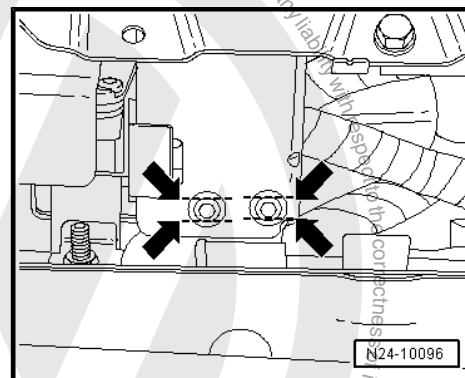
The procedure for the second shear bolt is exactly the same.



i Note

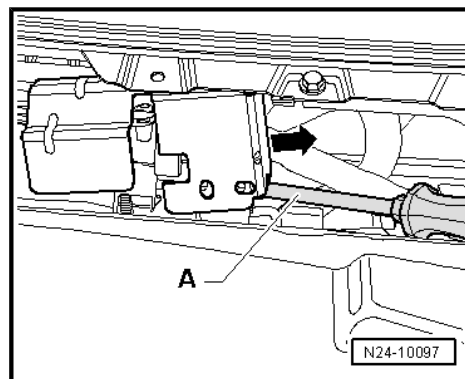
If screws cannot be removed, saw into heads of shear bolts so that two parallel surfaces are formed -arrows- and then remove them.

- Insert a screwdriver -A- between protective housing and retaining plate -arrow-.

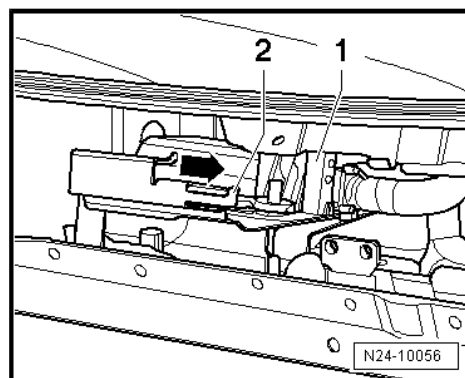




- Pry off the protective housing with a screwdriver -A- and pull it off the retaining plate -arrow-.

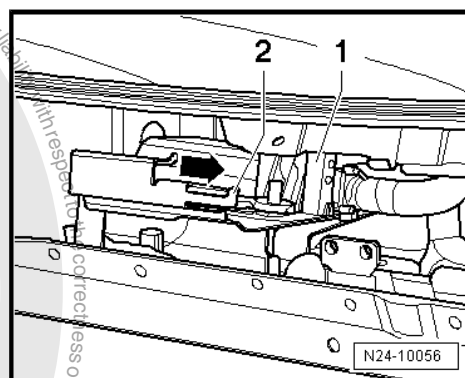


- Disconnect the front connector -1- from the engine control module.
- Pry up locking mechanism -2- slightly.
- Then slide the engine control module out of the retainer -arrow-.
- Now disengage rear harness connector from Engine Control Module (ECM) and disconnect it.

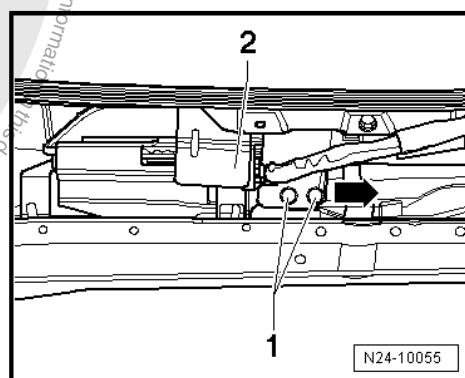


Installing

- Connect the rear harness connector to engine control module and engage it.
- Slide the engine control module onto the retaining plate.
- Push the locking mechanism -2- against the engine control module.
- Connect the front connector -1- to the engine control module.
- Slide protective housing on to retaining plate.



- Tighten shear bolts -1- uniformly until bolt heads shear off.
- Install the plenum chamber bulkhead. Refer to ➤ Body Exterior; Rep. Gr. 50 ; Plenum Chamber Bulkhead; Plenum Chamber Bulkhead - Assembly Overview .
- Install the wiper arms and the plenum chamber cover. Refer to ➤ Electrical Equipment; Rep. Gr. 92 ; Windshield Wiper System; Windshield Wiper System, Removing and Installing.





4.6 Engine Control Module, from 11/2008

Without Anti-Theft Immobilizer

⇒ ["4.6.1 Engine Control Module", page 227](#)

With anti-theft immobilizer

⇒ ["4.6.2 Engine Control Module", page 228](#)

4.6.1 Engine Control Module

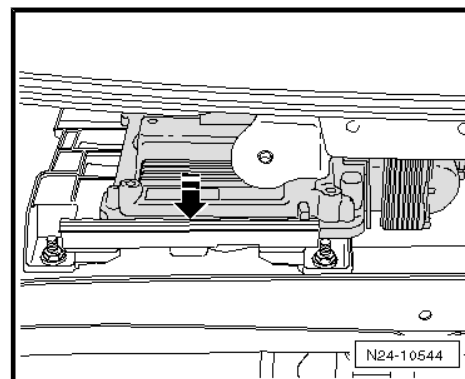


Note

If the engine control module will be replaced, connect the Vehicle Diagnostic Tester and perform the "Replacing Engine Control Module" guided function.

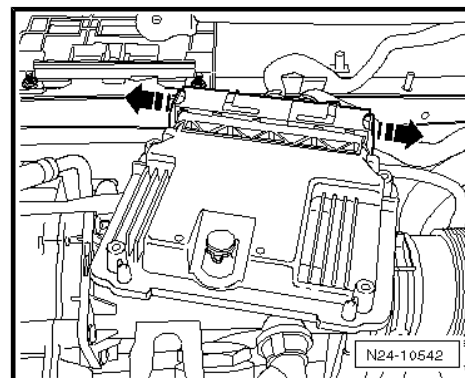
Removing

- Switch off the ignition.
- Remove windshield wiper arms ⇒ Electrical Equipment; Rep. Gr. 92 ; Front windshield wiper system; removing and installing wiper arms .
- Remove the plenum chamber bulkhead. Refer to ⇒ Body Exterior; Rep. Gr. 50 ; Body Front, Plenum Chamber Bulkhead
- Push the retaining frame in direction of -arrow- downward and remove the engine control module.



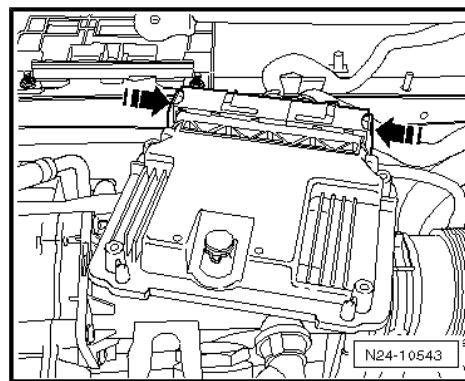
- Push the retainers in the direction of the -arrow- and disconnect the connector.

Installing

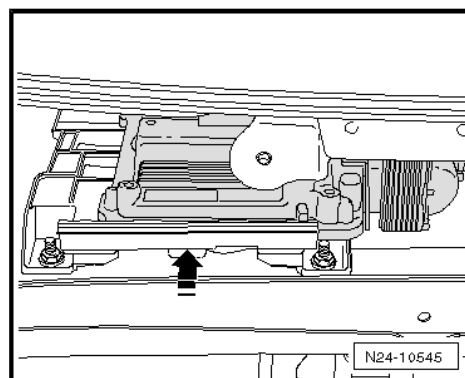




- Connect the connector on the engine control module and push the retainers all the way in the direction of the -arrow-.



- Mount the engine control module into the retaining frame and push it in direction of -arrow- upward.
- Install the plenum chamber bulkhead. Refer to ➤ Body Exterior; Rep. Gr. 50 ; Body Front, Plenum Chamber Bulkhead .
- Install windshield wiper arms. Refer to ➤ Electrical Equipment; Rep. Gr. 92 ; Front Windshield Wiper System; Removing And Installing Wiper Arms .



4.6.2 Engine Control Module

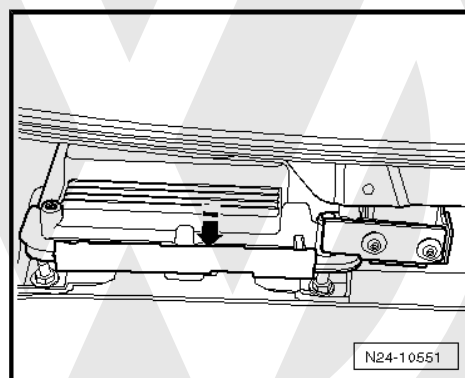


Note

If the engine control module will be replaced, connect the Vehicle Diagnostic Tester and perform the "Replacing Engine Control Module" guided function.

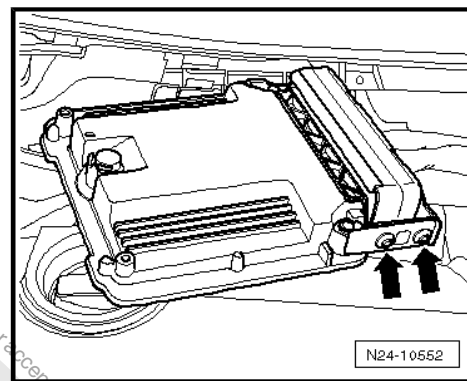
Removing

- Switch off the ignition.
- Remove windshield wiper arms ➤ Electrical Equipment; Rep. Gr. 92 ; Front windshield wiper system; removing and installing wiper arms .
- Remove the plenum chamber bulkhead. Refer to ➤ Body Exterior; Rep. Gr. 50 ; Body Front, Plenum Chamber Bulkhead .
- Push the retaining frame in direction of -arrow- downward and remove the engine control module.

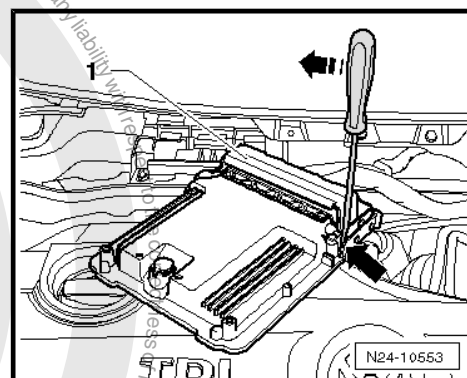




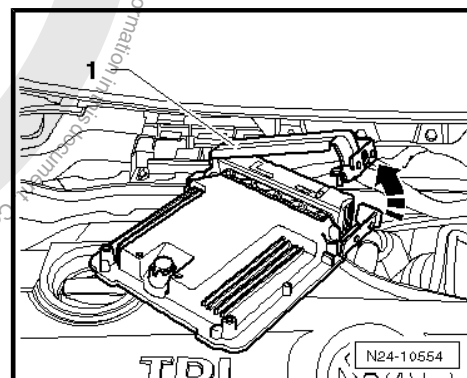
- Remove the shear bolts -arrows- with pliers.



- Slide a screwdriver between both locking plates -arrow-.
- Carefully push the driver in direction of -arrow- and at the same time bend the locking bracket -1- upward.

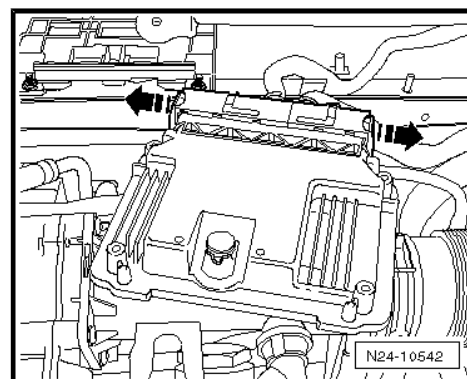


- Bend the locking bracket -1- in the direction of the -arrow- until it can be removed from the connectors.



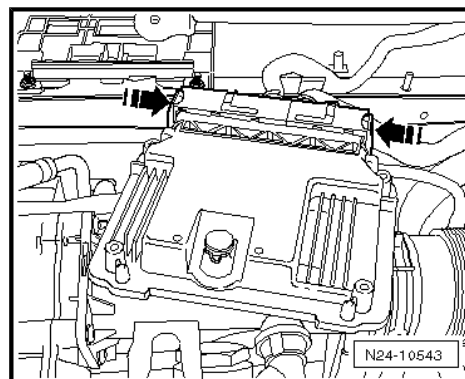
- Push the retainers in the direction of the -arrow- and disconnect the connector.

Installing

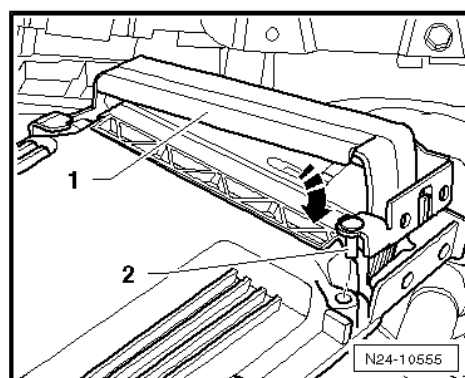




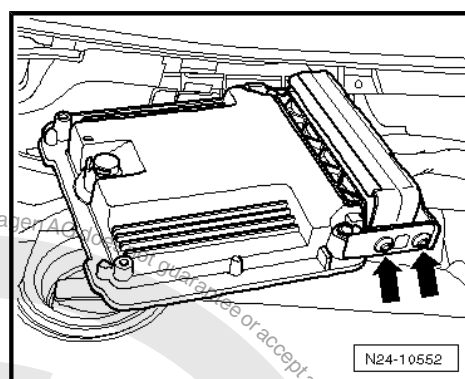
- Connect the connector on the engine control module and push the retainers all the way in the direction of the -arrow-.



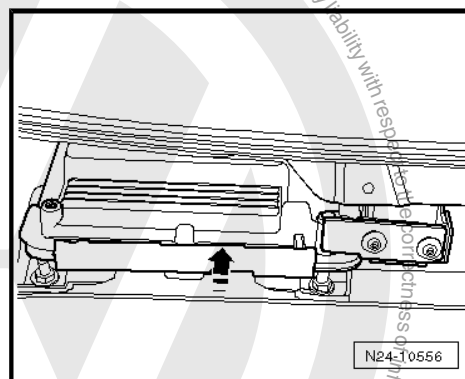
- Place the locking bracket -1- on the connectors and press it in the direction of the -arrow-.
- Tighten the bolts -2- in the hole on the engine control module as far as the stop.



- Secure the locking bracket to the engine control module -arrows- with new shear bolts.
- Tighten the shear bolts evenly until the bolt heads break off -arrows-.



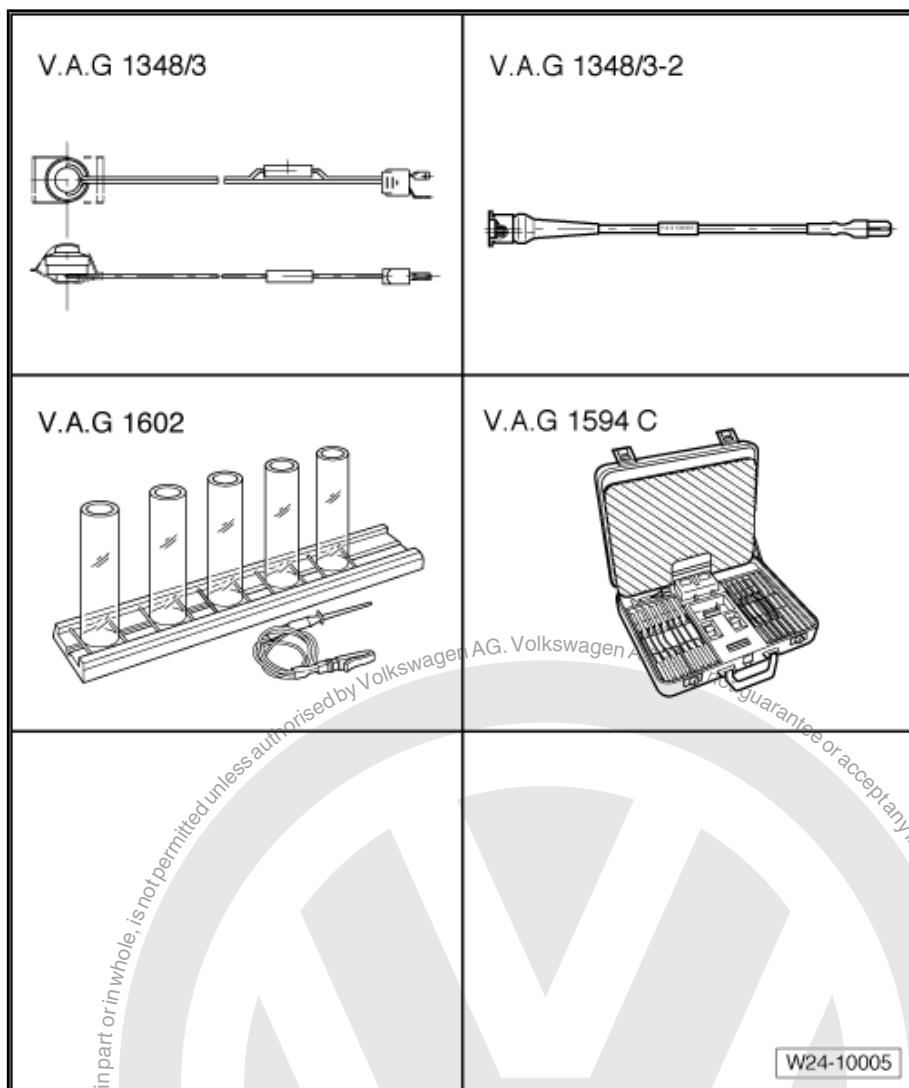
- Mount the engine control module into the retaining frame and push it in direction of -arrow- upward.
- Install the plenum chamber bulkhead. Refer to ➤ Body Exterior; Rep. Gr. 50 ; Body Front, Plenum Chamber Bulkhead .
- Install windshield wiper arms. Refer to ➤ Electrical Equipment; Rep. Gr. 92 ; Front Windshield Wiper System; Removing And Installing Wiper Arms .





5 Special Tools

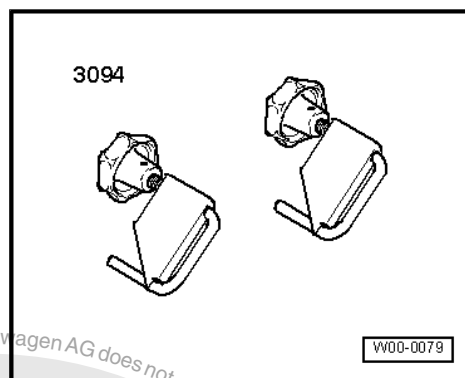
Special tools and workshop equipment required



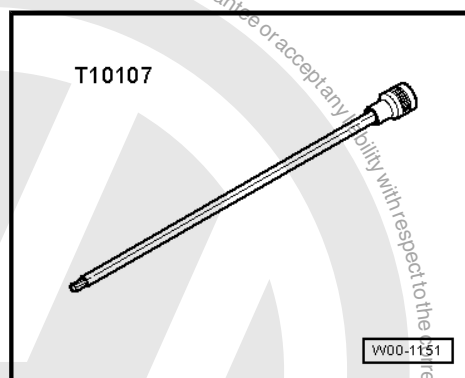
- ◆ Injection Rate Comparison Meter Kit - Remote Cable - VAG1348/3A-
- ◆ Injection Rate Comparison Meter Kit - Adapter - VAG1348/3-2-
- ◆ Injection Rate Tester - VAG1602-
- ◆ Connector Test Set - VAG1594D-
- ◆ Vehicle Diagnostic Tester - Test Adapter - 5 Pin - VAS5565-



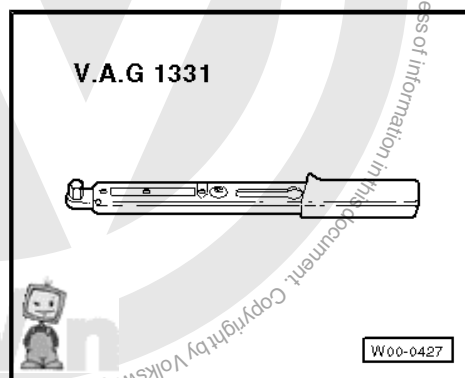
◆ Hose Clamps - Up To 25mm - 3094-



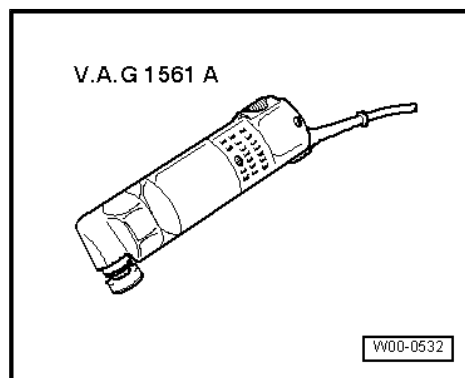
◆ Socket and Extended Bit - T10107A-



◆ Torque Wrench 1331 5-50Nm - VAG1331-



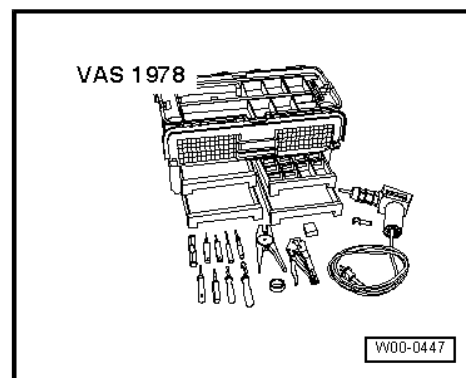
◆ Window Cutter - VAG1561A-



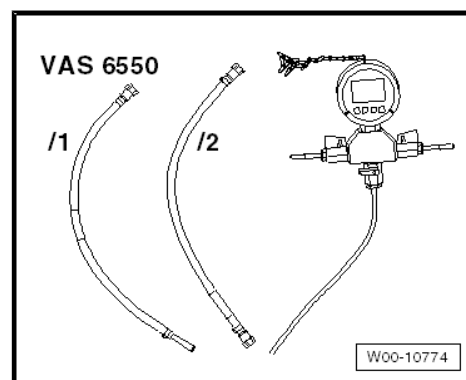
◆ Window Cutter - Saw Set - VAG1561/14-



◆ Wiring Harness Repair Set - VAS1978B- .



◆ Pressure Tester Kit - VAS6550-





26 – Exhaust System, Emission Controls

1 General Information

⇒ [“1.1 Exhaust System Components”, page 234](#)

⇒ [“1.2 Secondary Air Injection System”, page 235](#)

1.1 Exhaust System Components

Special tools and workshop equipment required

- ◆ Ring Wrench 7-Piece Set - 3337-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Pneumatic Body Saw - VAS6780-
- ◆ Hot Bolt Paste - G 052 118 A3-



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *Ensure sufficient clearance to all moving or hot components.*



Note

- ◆ *After exhaust system repairs, make sure exhaust system is not under stress and that it has sufficient clearance from the bodywork. If necessary, loosen clamp(s) and align exhaust pipe so that sufficient clearance is maintained to the bodywork and support rings carry uniform loads.*
- ◆ *Gaskets and self-locking nuts must be replaced.*

Refer to:

⇒ [“2.1 Overview - Exhaust Manifold with Attachments”, page 236](#)

⇒ [“2.2 Overview - Front Exhaust Pipe with Catalytic Converter and Attachments”, page 237](#)

⇒ [“2.3 Overview - Front Exhaust Pipe with Catalytic Converter and Attachments”, page 239](#)

⇒ [“2.4 Overview - Muffler with Mounts”, page 241](#)

⇒ [“4.1 Front Exhaust Pipe with Catalytic Converter, Removing and Installing”, page 246](#)

⇒ [“4.2 Middle and Rear Mufflers, Separating and Connecting”, page 247](#)

⇒ [“4.3 Exhaust System, Installing without Tension”, page 248](#)



1.2 Secondary Air Injection System

Function

Air is blown briefly into the exhaust valves by the secondary air injection system during a cold start. This produces an oxygen rich exhaust gas, causes afterburning and reduces the heating-up phase of the catalytic converter.



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.*





2 Description and Operation

⇒ [“2.1 Overview - Exhaust Manifold with Attachments”, page 236](#)

BTK, CBTA and CCCA

⇒ [“2.2 Overview - Front Exhaust Pipe with Catalytic Converter and Attachments”, page 237](#)

BGQ and CBUA

⇒ [“2.3 Overview - Front Exhaust Pipe with Catalytic Converter and Attachments”, page 239](#)

⇒ [“2.4 Overview - Muffler with Mounts”, page 241](#)

⇒ [“2.5 Overview - Secondary Air Injection System”, page 242](#)

2.1 Overview - Exhaust Manifold with Attachments

1 - Seal

- ☐ Replace

2 - Bolt

- ☐ 23 Nm
- ☐ Replace

3 - Exhaust Manifold

- ☐ Coat stud bolts on cylinder head with Hot Bolt Paste - G 052 118 A3- .
- ☐ Remove upward

4 - Clip

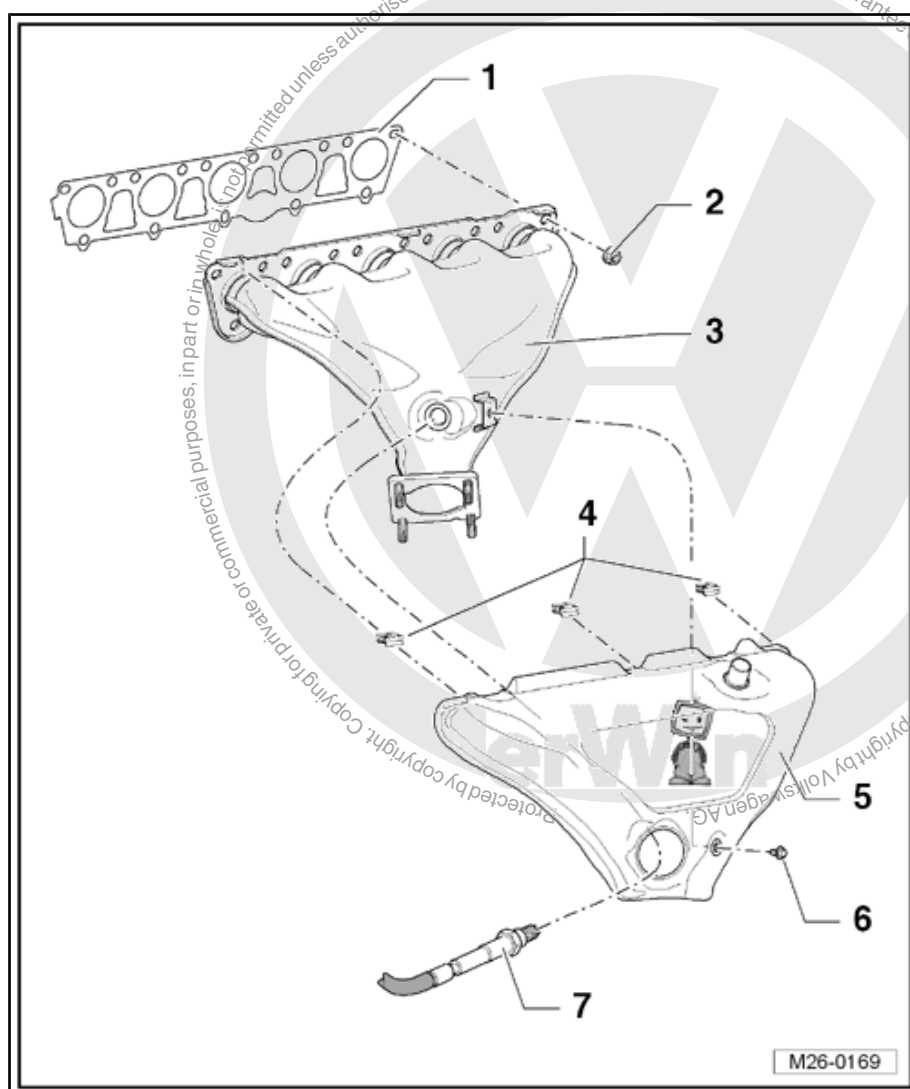
5 - Heat Shield

6 - Bolt

- ☐ 10 Nm

7 - Heated Oxygen Sensor - G39- , 55 Nm

- ☐ Removing and installing with Ring Wrench 7-Piece Set - 3337-
- ☐ Coat the threads on the new heated oxygen sensors with assembly paste.
- ☐ For a reused heated oxygen sensor, only grease the threads with Hot Bolt Paste - G 052 112 A3- . Do not let the paste enter the slits on the sensor body.
- ☐ If sealing ring is leaking cut open and replace.
- ☐ Connector color: black





2.2 Overview - Front Exhaust Pipe with Catalytic Converter and Attachments

1 - Exhaust Manifold

- ☐ Coat the stud bolts with Hot Bolt Paste - G 052 118 A3- .

2 - Seal

- ☐ Replace
- ☐ Note installation position:

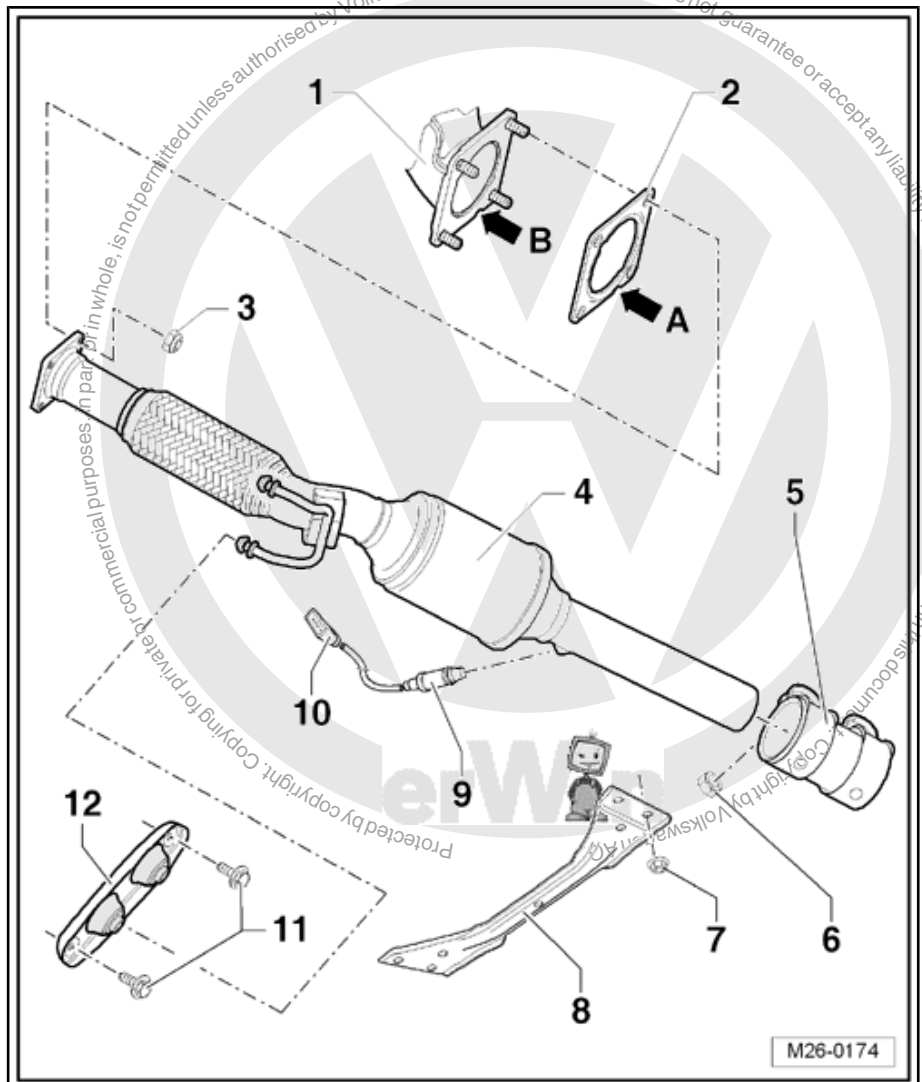
Gasket recess -arrow A- must be located at exhaust manifold recess -arrow B-.

3 - Bolt

- ☐ 23 Nm
- ☐ Replace

4 - Front Exhaust Pipe

- ☐ With catalytic converter
- ☐ Protect from shocks and impact stress
- ☐ With a flex joint
- ☐ Decoupling element must not be bent more than 10° - otherwise it may be damaged
- ☐ Removing and installing. Refer to
 ⇒ ["4.1 Front Exhaust Pipe with Catalytic Converter, Removing and Installing", page 246](#) .
- ☐ Exhaust System, Installing without Tension. Refer to
 ⇒ ["4.3 Exhaust System, Installing without Tension", page 248](#) .



5 - Clamp

- ☐ Before tightening, ensure exhaust system is tension-free. Refer to
 ⇒ ["4.3 Exhaust System, Installing without Tension", page 248](#) .
- ☐ Installed position. Refer to ⇒ [Fig. "Installation position of clamp", page 238](#)
- ☐ Tighten bolts evenly

6 - Bolt

- ☐ 23 Nm

7 - Bolt

- ☐ 20 Nm

8 - Front Crossmember

9 - Oxygen Sensor after Three Way Catalytic Converter - G130- , 55 Nm

- ☐ Removing and installing with Ring Wrench 7-Piece Set - 3337-
- ☐ Coat the threads on the new heated oxygen sensors with assembly paste.
- ☐ For a reused heated oxygen sensor, only grease the threads with Hot Bolt Paste - G 052 112 A3- . Do not let the paste enter the slits on the sensor body.
- ☐ If sealing ring is leaking cut open and replace.



10 - Connector

- ☐ Brown, 4-pin
- ☐ Installed position. Refer to
⇒ Fig. [“Harness connector for oxygen sensor - installation position”](#), page 238

11 - Bolt

- ☐ 23 Nm

12 - Suspended Mount

- ☐ Replace if damaged

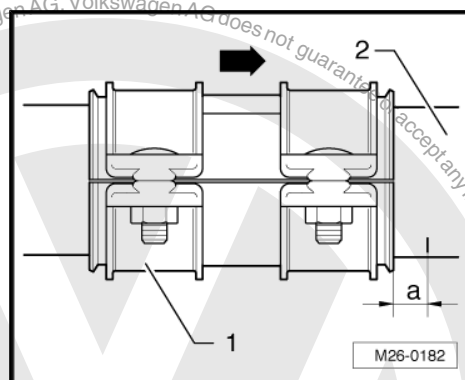
Installation position of clamp

The -arrow- points in the direction of travel.

- Line up the clamp -1- with the marking on the catalytic converter -2-.

-a- = 5 mm

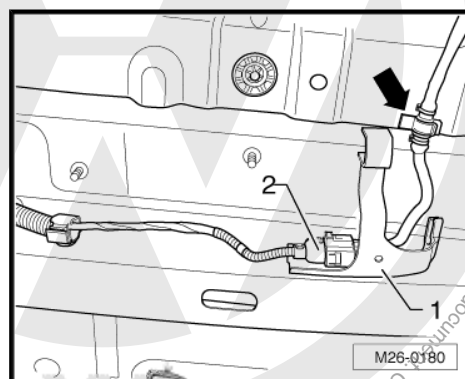
Mounting bolts must not project beyond the lower edge of the clamp.



Harness connector for oxygen sensor - installation position

Harness connector is located at right on vehicle floor under cover.

- 1 - Mount
- 2 - Connector for Oxygen Sensor after Three Way Catalytic Converter - G130- , brown





2.3 Overview - Front Exhaust Pipe with Catalytic Converter and Attachments

1 - Exhaust Manifold

- ☐ Coat the stud bolts with Hot Bolt Paste - G 052 118 A3- .

2 - Seal

- ☐ Replace
- ☐ Note installation position:

Gasket recess -arrow A- must be located at exhaust manifold recess -arrow B-.

3 - Connector

- ☐ Black, 4-pin

4 - Oxygen Sensor in Bank 1 Center Three Way Catalytic Converter - Z59- , 55 Nm

- ☐ Removing and installing with Ring Wrench 7-Piece Set - 3337-
- ☐ Coat the threads on the new heated oxygen sensors with assembly paste.
- ☐ For a reused heated oxygen sensor, only grease the threads with Hot Bolt Paste - G 052 112 A3- . Do not let the paste enter the slits on the sensor body.
- ☐ If sealing ring is leaking cut open and replace.

5 - Spring Nut

- ☐ Insert from front

6 - Clamp

- ☐ Before tightening, ensure exhaust system is tension-free. Refer to [⇒ "4.3 Exhaust System, Installing without Tension", page 248](#) .
- ☐ Installed position. Refer to [⇒ Fig. "Installation position of clamp" , page 240](#)
- ☐ Tighten bolts evenly

7 - Bolt

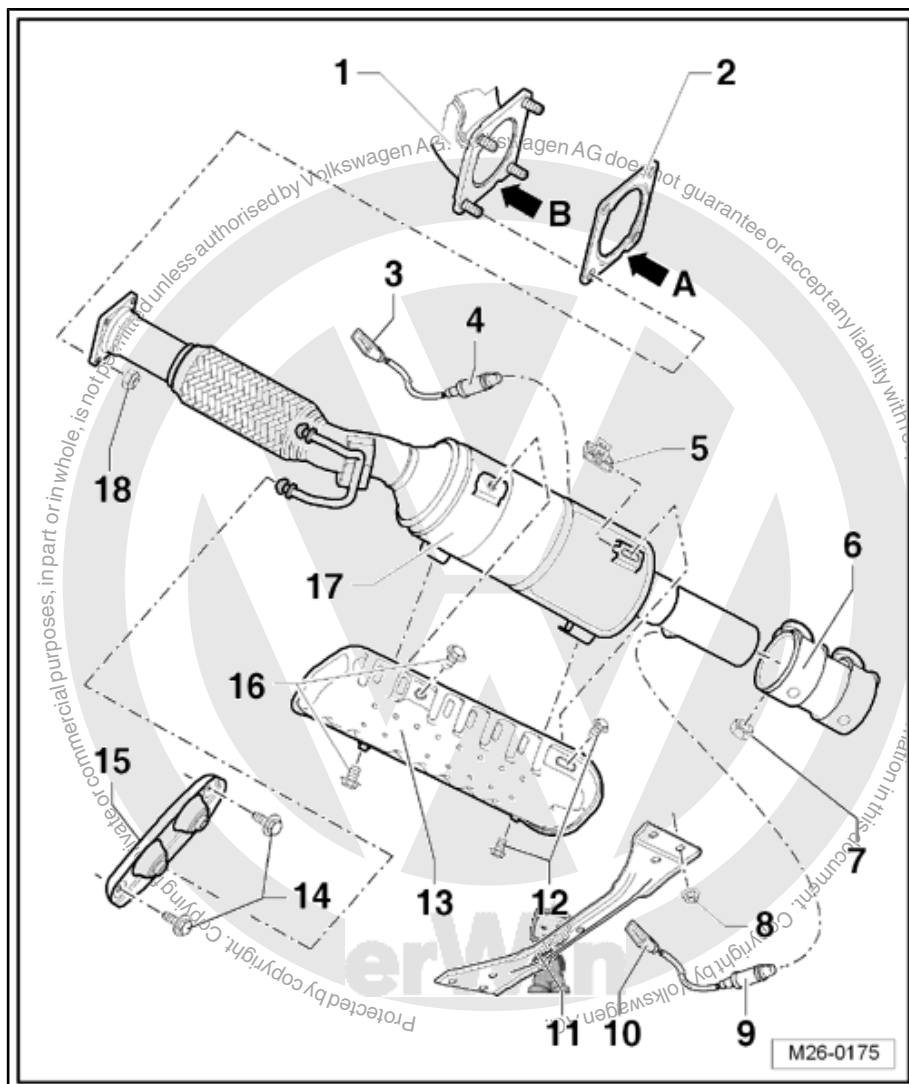
- ☐ 23 Nm

8 - Bolt

- ☐ 20 Nm

9 - Oxygen Sensor after Three Way Catalytic Converter - G130- , 55 Nm

- ☐ Removing and installing with Ring Wrench 7-Piece Set - 3337-
- ☐ Coat the threads on the new heated oxygen sensors with assembly paste.
- ☐ For a reused heated oxygen sensor, only grease the threads with Hot Bolt Paste - G 052 112 A3- . Do not let the paste enter the slits on the sensor body.
- ☐ If sealing ring is leaking cut open and replace.





10 - Connector

- ☐ Brown, 4-pin
- ☐ Installed position. Refer to
⇒ [Fig. "Harness connector for oxygen sensors - installation position", page 241](#)

11 - Front Crossmember

12 - Bolt

- ☐ 5 Nm

13 - Shield

- ☐ For catalytic converter

14 - Bolt

- ☐ 23 Nm

15 - Suspended Mount

- ☐ Replace if damaged

16 - Bolt

- ☐ 10 Nm

17 - Front Exhaust Pipe

- ☐ With catalytic converter
- ☐ Protect from shocks and impact stress
- ☐ With a flex joint
- ☐ Decoupling element must not be bent more than 10° - otherwise it may be damaged
- ☐ Removing and installing. Refer to
⇒ ["4.1 Front Exhaust Pipe with Catalytic Converter, Removing and Installing", page 246](#) .
- ☐ Exhaust System, Installing without Tension. Refer to
⇒ ["4.3 Exhaust System, Installing without Tension", page 248](#)

18 - Bolt

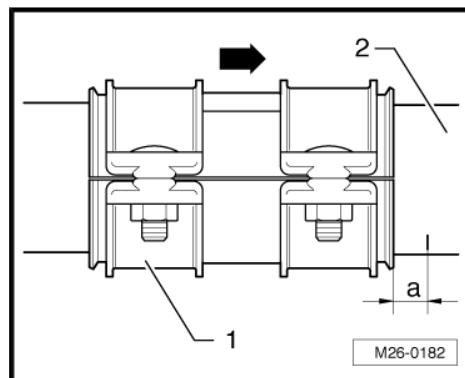
- ☐ 23 Nm
- ☐ Replace

Installation position of clamp

The -arrow- points in the direction of travel.

- Line up the clamp -1- with the marking on the catalytic converter -2-.
- a- = 5 mm

The bolts must be on right side. They must not project beyond the lower edge of the clamp.

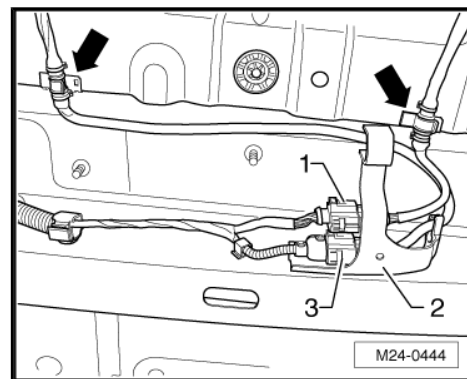




Harness connector for oxygen sensors - installation position

The connectors are located to the right, on the vehicle floor under the cover.

- 1 - Connector for Oxygen Sensor after Three Way Catalytic Converter - G130- , brown
- 2 - Mount
- 3 - Connector for Oxygen Sensor in Bank 1 Center Three Way Catalytic Converter - G465- , black



2.4 Overview - Muffler with Mounts

1 - From Front Exhaust Pipe

2 - Bolt

- ☐ 26 Nm
- ☐ Replace
- ☐ For attaching the fuel tank

3 - Suspended Mount

4 - Bolt

- ☐ 23 Nm

5 - Center Muffler

- ☐ Original equipment as one unit with rear muffler. For repairs, replace each separately
- ☐ Exhaust System, Installing without Tension. Refer to [⇒ "4.3 Exhaust System, Installing without Tension", page 248](#).
- ☐ Exhaust System, Separating. Refer to [⇒ "4.2 Middle and Rear Mufflers, Separating and Connecting", page 247](#).

6 - Retaining Loop

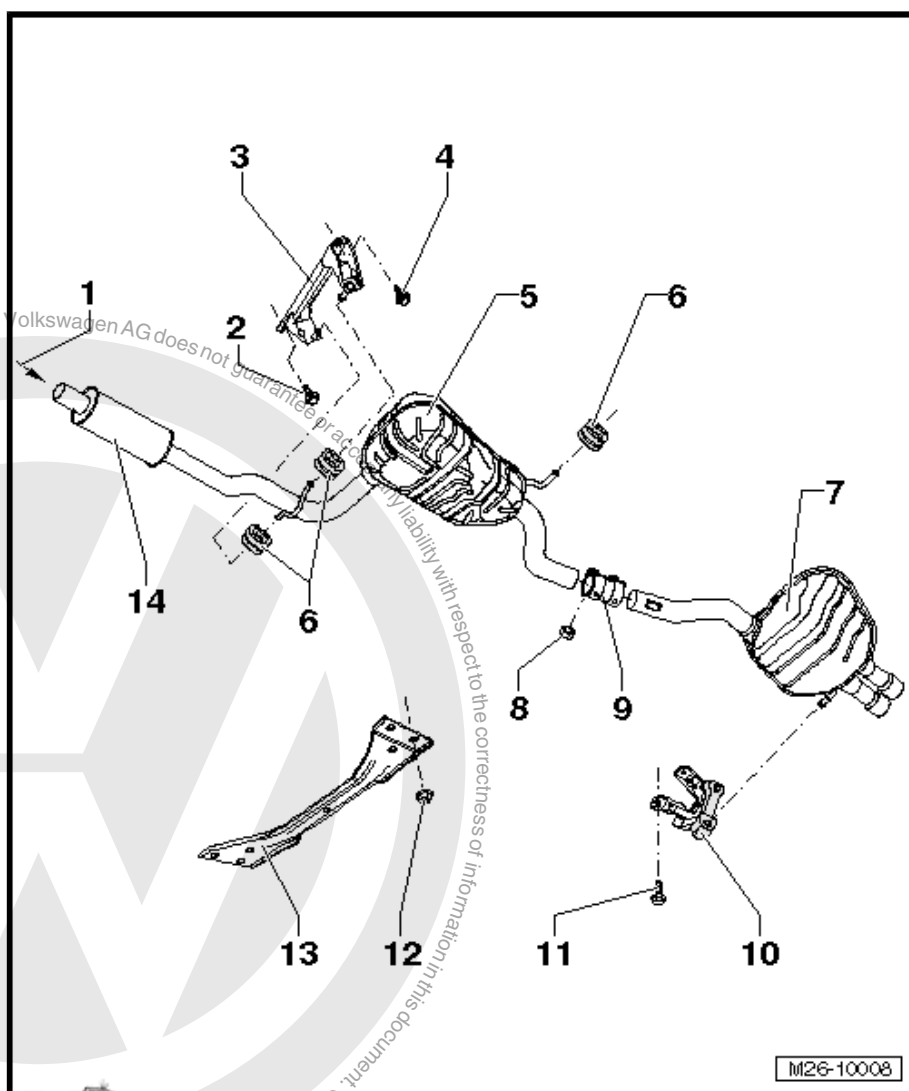
- ☐ Replace if damaged

7 - Rear Muffler

- ☐ Original equipment as one unit with center muffler. For repairs, replace each separately
- ☐ Exhaust System, Installing without Tension. Refer to [⇒ "4.3 Exhaust System, Installing without Tension", page 248](#).
- ☐ Exhaust System, Separating. Refer to [⇒ "4.2 Middle and Rear Mufflers, Separating and Connecting", page 247](#).

8 - Bolt

- ☐ 23 Nm





9 - Repair Clamp

- ☐ For individual replacement of center and rear mufflers
- ☐ Installed position ⇒ [“4.2 Middle and Rear Mufflers, Separating and Connecting”, page 247](#)
- ☐ Tighten bolts evenly

10 - Suspended Mount

- ☐ Replace if damaged

11 - Bolt

- ☐ 23 Nm

12 - Bolt

- ☐ 20 Nm

13 - Rear Cross Member

14 - Front Muffler

- ☐ From MY 2006

2.5 Overview - Secondary Air Injection System



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.*



Note

The secondary air injection system is no longer installed in vehicles with engine code CBTA from MY 2010.

- 10 Nm

2 - Connecting Pipe

- ❑ Observe the tightening sequence. Refer to Fig. “Connecting tube - tightening sequence”, page 244.
- ❑ Engine codes BGP, BGQ and CBUA only

3 - Connector

- ❑ For the Secondary Air Injection Solenoid Valve - N112-

4 - Secondary Air Injection Solenoid Valve - N112-

- ❑ Do not disassemble
- ❑ Checking. Refer to
⇒ “3.1 Secondary Air In-
jection Solenoid Valve
N112 „Checking”,
page 245 .

5 - Pressure Pipe

- ☒ Make sure it is secure
- ☐ To disengage, squeeze together securing ring

6 - Secondary Air Injection

Sensor 1 - G609-

- Installed from MY 2009

7 - Bolts

- ❑ 2 Nm
- ❑ Installed from MY 2009

8 - Mount

9 - Seal

- ❑ Allocation. Refer to the Parts Catalog

10 - Bolt

- 10 Nm

11 - Intake Manifold

- ❑ For secondary air injection pump

12 - Secondary Air Injection Pump Motor - V101-


- ❑ Removing and installing. Refer to
⇒ “4.4 Secondary Air Injection Pump Motor V101 , Removing and Installing”, page 249 .

13 - Rubber Bushing

14 - Bolt

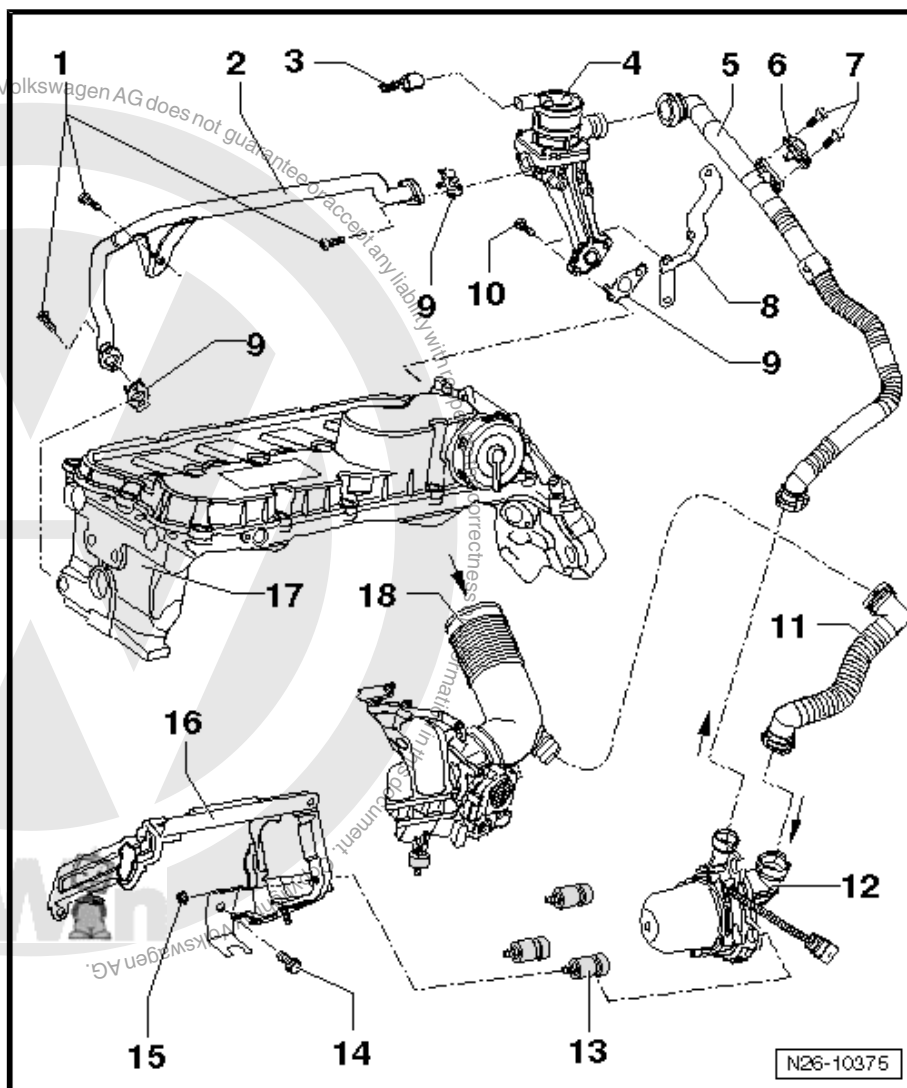
- 25 Nm

15 - Bolt

-  10 Nm

16 - Intake Manifold Support

- ☐ With mount for Secondary Air Injection Pump Motor - V101-



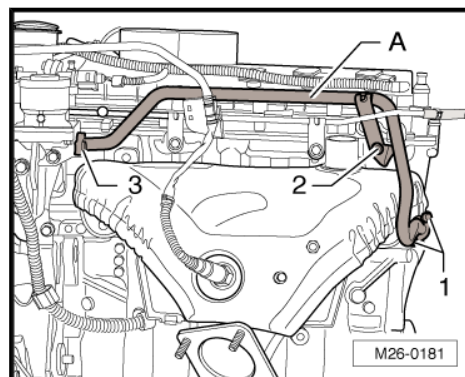


17 - Cylinder Head

18 - Intake Hose

Connecting tube - tightening sequence

- Replace all connecting pipe seals -A-.
- Screw in all bolts only hand-tight.
- First tighten the bolts -1-, then the bolt -2- and finally the bolts -3- to 10 Nm.





3 Diagnosis and Testing

⇒ **"3.1 Secondary Air Injection Solenoid Valve N112, Checking", page 245**

3.1 Secondary Air Injection Solenoid Valve - N112- , Checking

Special tools and workshop equipment required

- ◆ Connector Test Set - VAG1594D-
- ◆ Assisting hose, for example coolant hose



Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.*

Test Sequence



Note

Do not use compressed air during following check!

- Remove the engine cover with air filter. Refer to [⇒ "4.1 Engine Cover with Air Filter", page 216](#) .
- Disconnect the pressure hose -2- from the Secondary Air Injection Solenoid Valve - N112- -3-. To do so, compress securing ring.
- Disconnect the connecting piece -4-.
- Slide the adapter hose -1-, for example coolant hose, into the Secondary Air Injection Solenoid Valve - N112- .
- Blow forcefully into the hose -arrow-.

The valve must be closed.

If air can be blown through valve with assisting hose properly sealed:

- Replace the Secondary Air Injection Solenoid Valve - N112- .

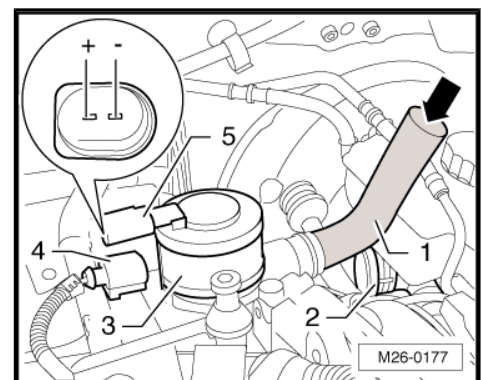
If the valve is closed:

- Connect terminals on connector connection -5- with adapter cables from Connector Test Set - VAG1594C- to battery positive (+) and negative (-).
- Blow forcefully into the hose -arrow-.

The valve must be opened.

If air cannot be blown through the valve with a properly sealed hose:

- Replace the Secondary Air Injection Solenoid Valve - N112- .





4 Removal and Installation

⇒ "4.1 Front Exhaust Pipe with Catalytic Converter, Removing and Installing", page 246

⇒ "4.2 Middle and Rear Mufflers, Separating and Connecting", page 247

⇒ "4.3 Exhaust System, Installing without Tension", page 248

⇒ "4.4 Secondary Air Injection Pump Motor V101, Removing and Installing", page 249

4.1 Front Exhaust Pipe with Catalytic Converter, Removing and Installing

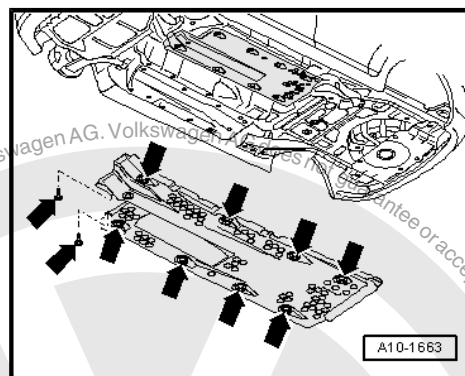
Special tools and workshop equipment required

- ♦ Torque Wrench 1331 5-50Nm - V.A.G1331-
- ♦ Hot Bolt Paste - G 052 118 A3-

Removing

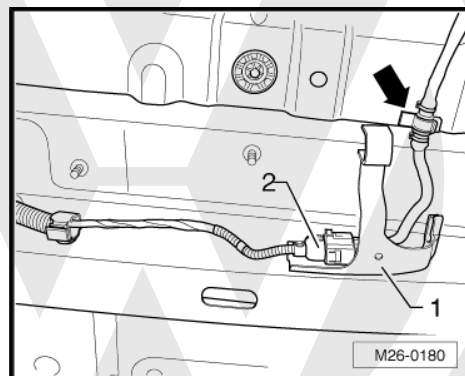
- Remove the right underbody panel (if equipped) -arrows-.

Engine codes BGP, BTK, CBTA and CCCA



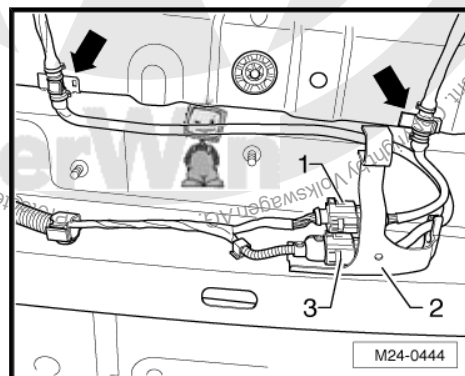
- Unclip the wire -arrow-, pull off bracket -1- and disconnect the connector -2- for Oxygen Sensor after Three Way Catalytic Converter - G130- .

Engine codes BGQ and CBUA



- Unclip lines -arrows-, pull off bracket -2- and separate connectors -1- for Oxygen Sensor after Three Way Catalytic Converter - G130- and -3- for Oxygen Sensor in Bank 1 Center Three Way Catalytic Converter - G465- .

Continuation for all





- Loosen the screws on the clamp -1-. The front crossmember for vehicle floor must not be removed.



Note

Flex joint in front exhaust pipe must not be bent more than 10 ° ; otherwise it may be damaged.

- Remove the nuts -2- on the front exhaust pipe/exhaust manifold and then the bolts -3-.
- Remove the front exhaust pipe -1- and catalytic converter from the exhaust manifold, push it them to the side and guide them under the front crossmember.

Installing

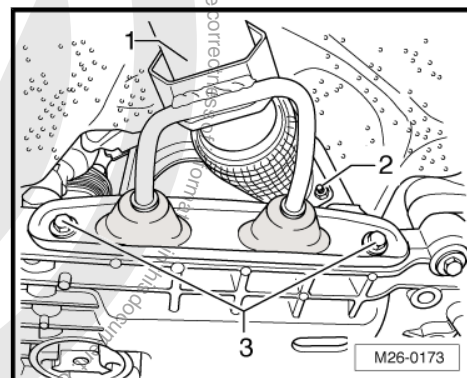
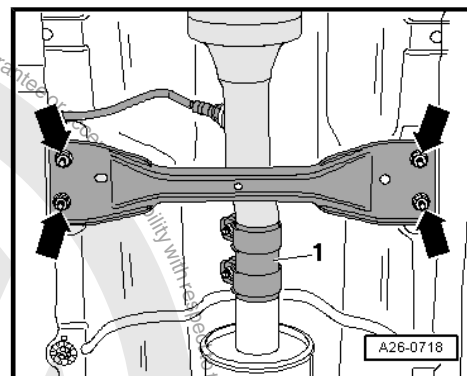
Install in reverse order of removal. Note the following:

- ◆ Replace gaskets and self-locking nuts.
- ◆ Install the exhaust system free of tension. Refer to ["4.3 Exhaust System, Installing without Tension", page 248](#).

Tightening specifications:

Component	Nm
Front exhaust pipe to exhaust manifold ◆ Replace nuts	25 ¹¹⁾
Mount to subframe	25
Clamp	25

11) Coat stud bolts on exhaust manifold with Hot Bolt Paste - G 052 118 A3- .



4.2 Middle and Rear Mufflers, Separating and Connecting

Special tools and workshop equipment required

- ◆ Pneumatic Body Saw - VAS6780- or
- ◆ Chain Pipe Cutter - VAS6254-
- ◆ Protective eyewear
- ◆ A separating point has been provided in the connecting pipe for individual replacement of the center or rear muffler.
- ◆ The separating point is marked a depression around the circumference of the exhaust pipe.

Separating



WARNING

To prevent injuries from metal shavings, wear protective goggles and protective clothing.



- Cut the exhaust pipe at a right angle at the separating point -arrow 2- using, for example a Body Saw - VAG1523 A- .

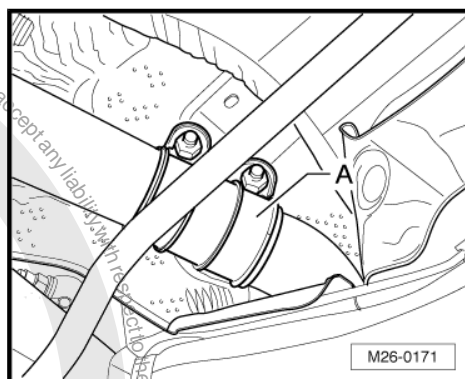
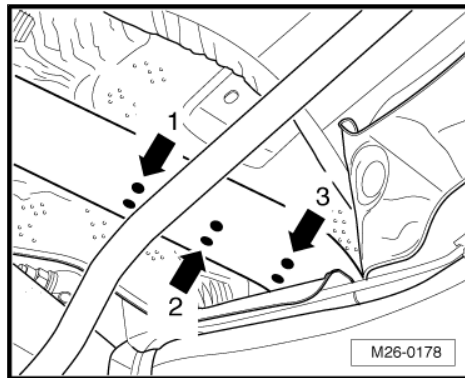
Connecting



Note

A second technician is required for tightening the repair clamp.

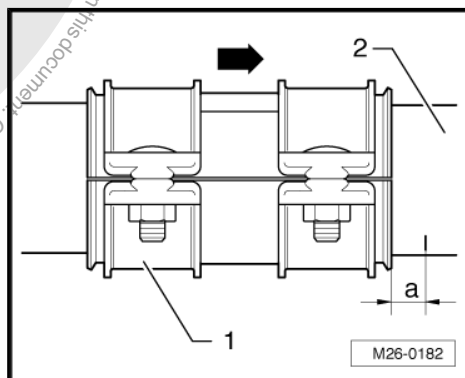
- Secure the center muffler in the mountings. The front clamp remains loosely placed on the pipes.
- Align rear muffler horizontally and hold it in this position.
- Position repair clamp at the side markings -arrow 1- and -arrow 3-.
- Turn the repair clamp -A- and tighten it to 25 Nm as illustrated.
- Then align exhaust system free of tension. Refer to [⇒ "4.3 Exhaust System, Installing without Tension", page 248](#).



4.3 Exhaust System, Installing without Tension

Special tools and workshop equipment required

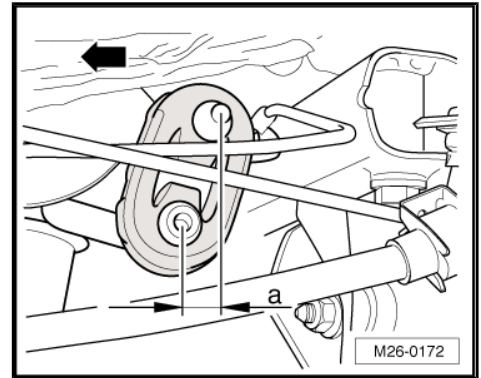
- ◆ Torque Wrench 1331 5-50Nm - V.A.G1331-
- Exhaust system must be aligned when cold.
- Loosen the threaded connections on the front clamp -1-.
- Position the clamp -1- so that dimension -a- for the marking on the pipe -2- equals 5 mm and then tighten the front bolt hand-tight. The -arrow- points in the direction of travel.





- Push the exhaust system as far forward until the dimension -a- on the outer retaining loop of the center muffler is 9 to 11 mm. The -arrow- points in the direction of travel.
- Tighten front clamp in this position uniformly to 25 Nm.

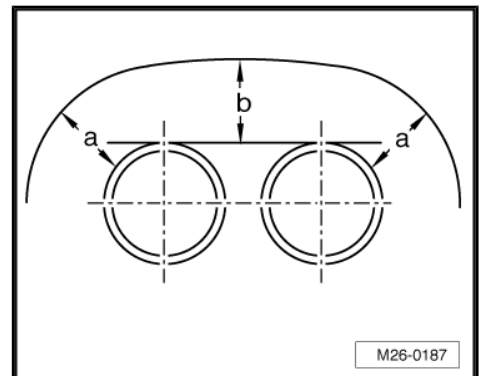
Aligning End Pipes



- Align the rear muffler so that the distance -a- between the cut-out for the bumper and the right and left tail pipes is the same.

At the same time, distance -b- of bumper cutout must run parallel to tail pipes.

- To align tail pipes, loosen rear muffler mounting components if necessary.



4.4 Secondary Air Injection Pump Motor - V101- , Removing and Installing



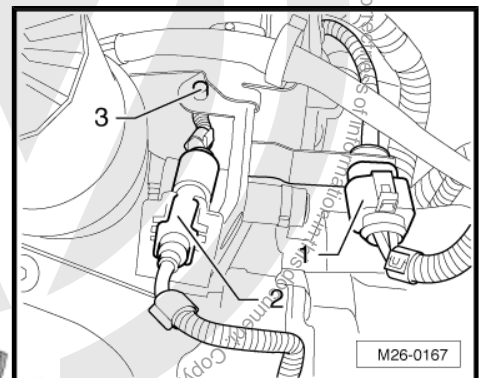
Caution

When doing any repair work, especially in the engine compartment, pay attention to the following due to clearance issues:

- ◆ *Route lines of all types (for example for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- ◆ *To prevent damage to the lines, make sure there is sufficient clearance to all moving or hot components.*

Removing

- Remove the noise insulation. Refer to ➔ Body Exterior; Rep. Gr. 50 ; Noise Insulation .
- Disconnect connectors -1- and -2-.
- Remove the clip -3- from the cable guide.
- Press out cable clip at top front mounting bolt.





- Remove the pressure hose -1- and the intake hose -2-. To do so, compress securing ring.
- Remove bolts and the Secondary Air Injection Pump Motor - V101- . When doing this, press lower bolt (rubber bushing) slightly in order to get by at transmission.

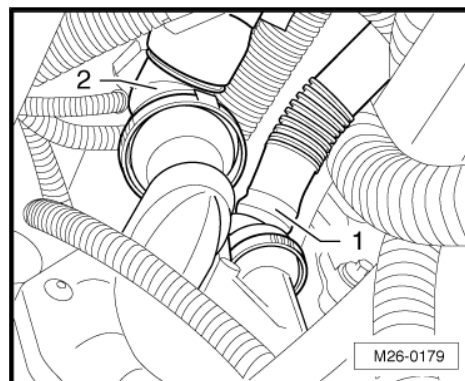
Installing

Install in reverse order of removal. Note the following:

- ♦ Make sure that pressure pipe and intake hose lock securely to Secondary Air Injection Pump Motor - V101- .

Tightening Specification:

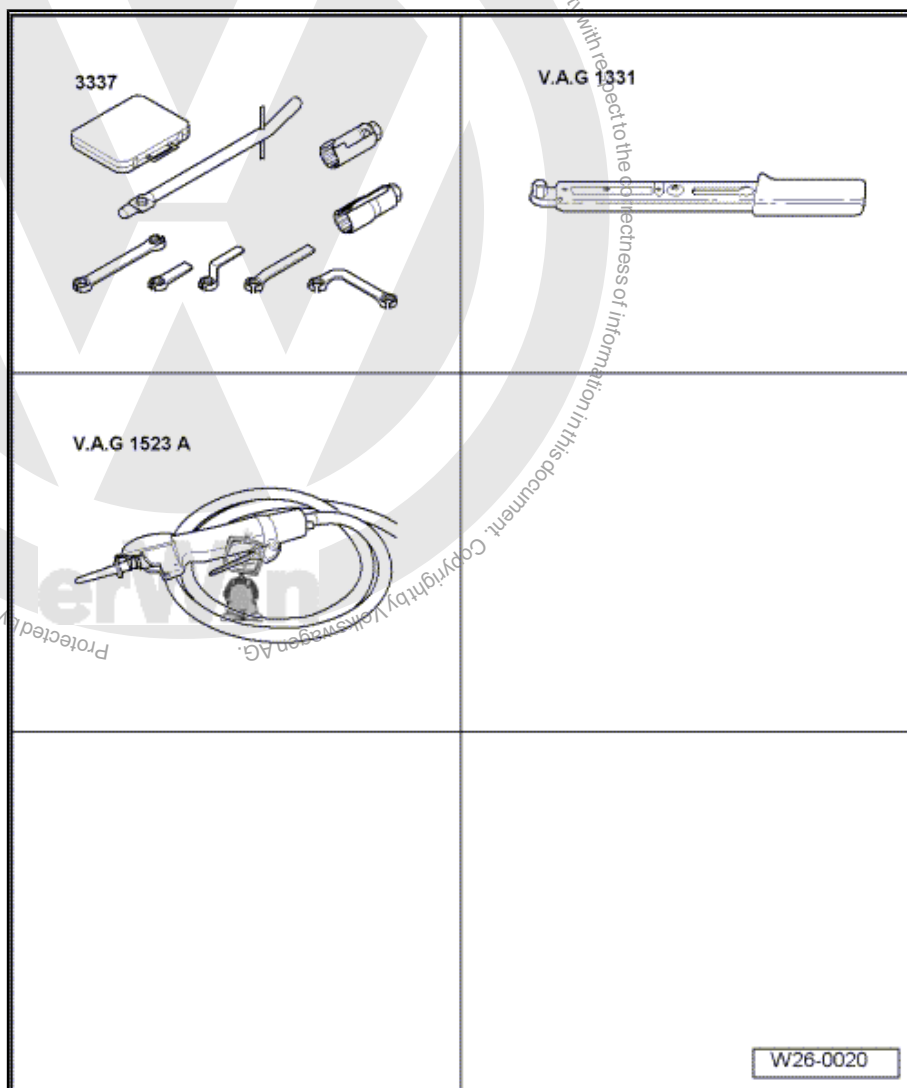
Component	Nm
Secondary Air Injection Pump Motor - V101- to intake manifold support	10



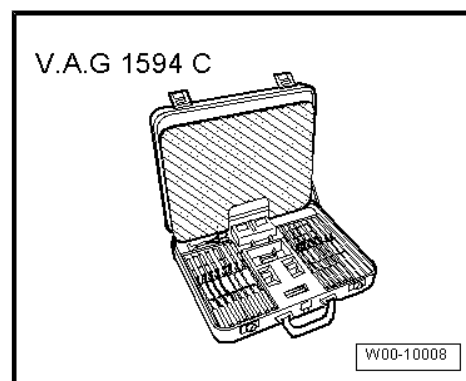


5 Special Tools

Special tools and workshop equipment required

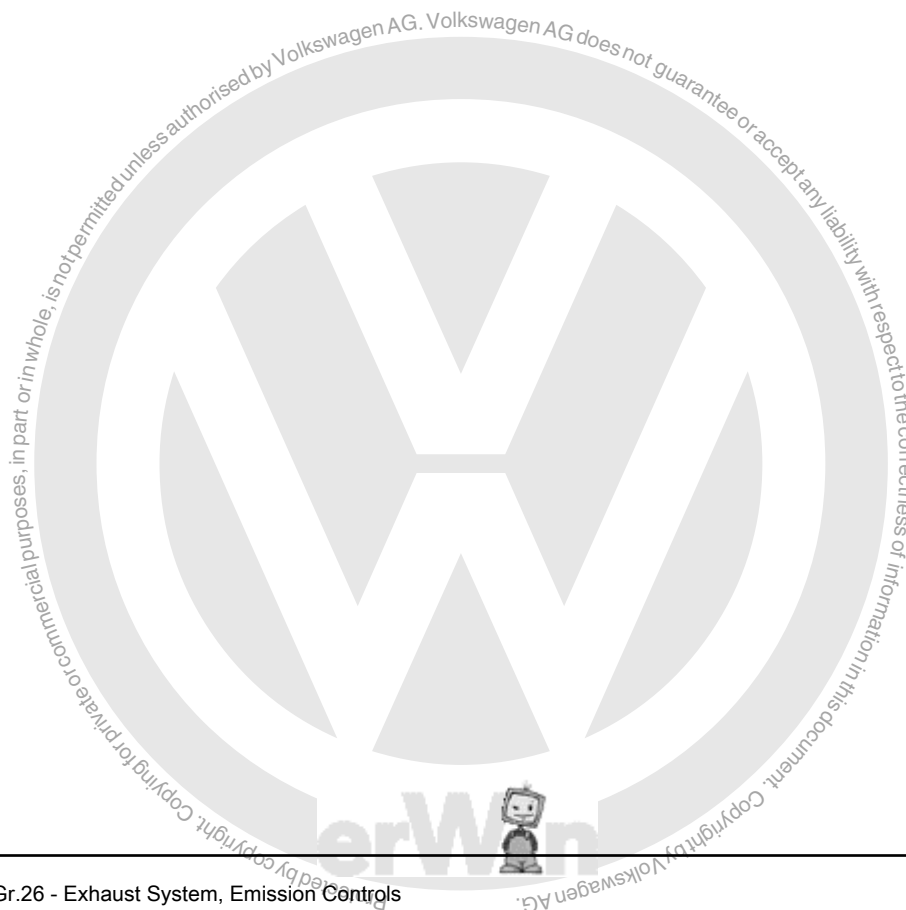
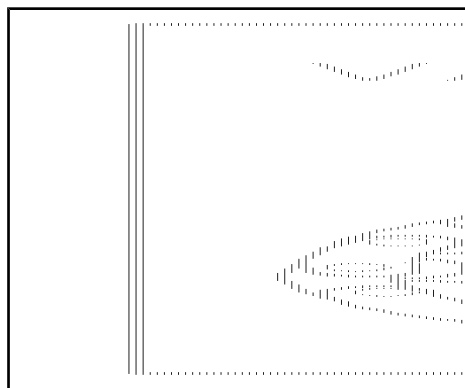


- ◆ Ring Wrench 7-Piece Set - 3337-
- ◆ Torque Wrench 1331 5-50Nm - VAG1331-
- ◆ Pneumatic Body Saw - VAS6780-
- ◆ Connector Test Set - VAG1594D-





◆ Chain Pipe Cutter - VAS6254-





28 – Ignition/Glow Plug System

1 General Information

⇒ [“1.1 Ignition System General Information”, page 253](#)

⇒ [“1.2 Safety Precautions”, page 253](#)

1.1 Ignition System General Information

Ignition System

- ◆ For proper function of the electrical components, a voltage of at least 11.5 V is required.
- ◆ It is possible that the control module will recognize a malfunction and store a DTC during some tests. Therefore after completing all checks and repairs the DTC memory must be checked and if necessary erased. Refer to
⇒ [“3.3 Engine Control Module DTC Memory, Checking and Erasing”, page 214](#).
- ◆ If the engine only starts briefly and then turns off again after troubleshooting, repairs or checking the components, it may be that the immobilizer is blocking the engine control module. The engine control module may have to be adapted then use the Vehicle Diagnostic Tester in “Guided Functions”.

1.2 Safety Precautions

To reduce the risk of personal injury and/or damage to the fuel injection and ignition system, always observe the following:

- ◆ Do not touch or disconnect ignition coils with power output stages when engine is running or turning at starting RPM.
- ◆ Only disconnect and reconnect wires for injection and ignition system, including test leads, if ignition is turned off.

If special testing equipment is required during road test, note the following:

- ◆ Test equipment must always be secured to the rear seat and operated from there by a second person.

If test and measuring instruments are operated from the front passenger seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.



2 Description and Operation

⇒ [“2.1 Overview - Ignition System”, page 254](#)

2.1 Overview - Ignition System

1 - Knock Sensor 2 - G66- Connecting Piece

- ☐ Gray
- ☐ Contacts gold plated
- ☐ Installed position. Refer to
⇒ [Fig. “Installation position of harness connectors for knock sensors”](#), page 255

2 - Knock Sensor 1 - G61- Connecting Piece

- ☐ Green
- ☐ Contacts gold plated
- ☐ Installed position. Refer to
⇒ [Fig. “Installation position of harness connectors for knock sensors”](#), page 255

3 - Knock Sensor 2 - G66-

- ☐ Pay attention to the installed position: the cable connect faces outward 45° to the right

4 - Knock Sensor 1 - G61-

- ☐ Pay attention to the installed position: the cable connection faces downward

5 - Bolt

- ☐ 20 Nm
- ☐ Tightening specifications affects function of Knock Sensor (KS).

6 - Ignition Coils with Power Output Stage - N70, N127, N291, N292, N323-

- ☐ Removing and installing. Refer to ⇒ [“4.1 Ignition Coils with Power Output Stages”, page 257](#) .

7 - Spark Plug

- ☐ 20 Nm
- ☐ Type and Electrode Gap. Refer to ⇒ [“3.1 Test Data and Spark Plugs”, page 256](#) .
- ☐ Remove and install with Spark Plug Removal Tool - 3122B-

8 - Bolt

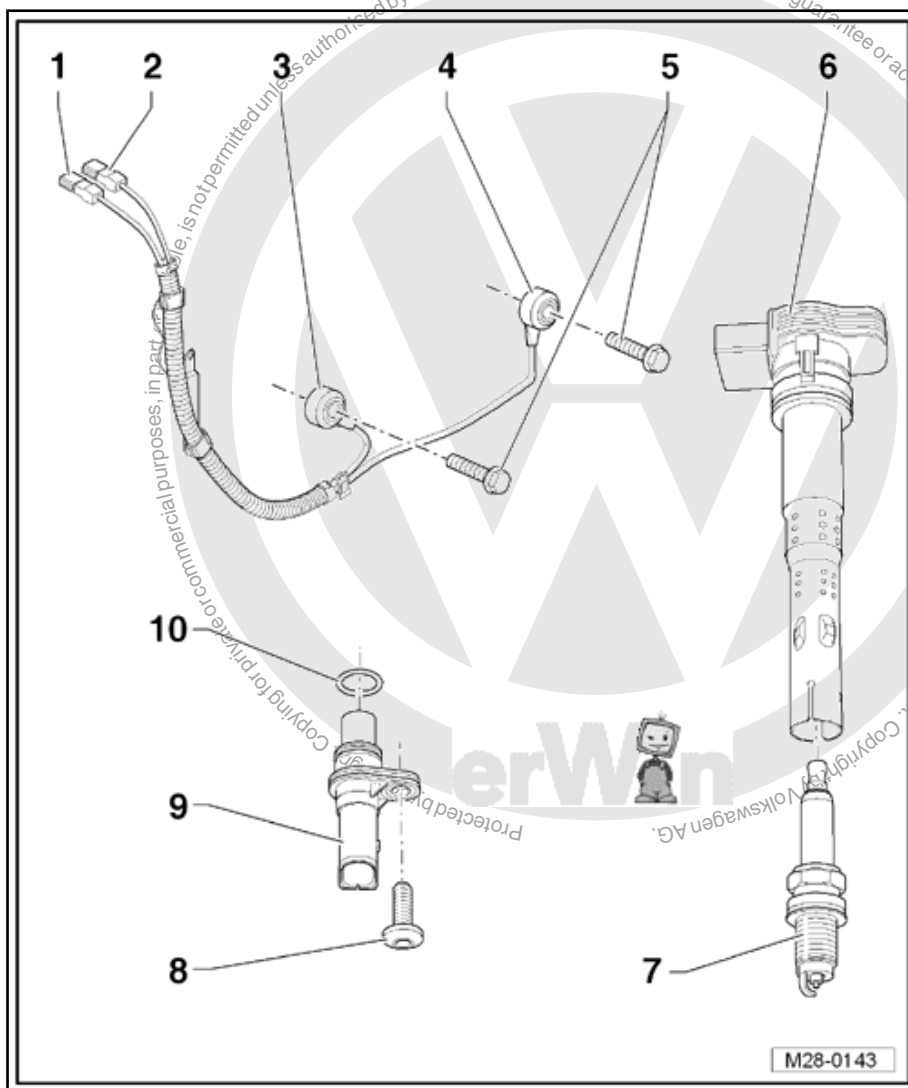
- ☐ 10 Nm

9 - Camshaft Position Sensor - G40-

- ☐ Contacts gold plated

10 - O-Ring

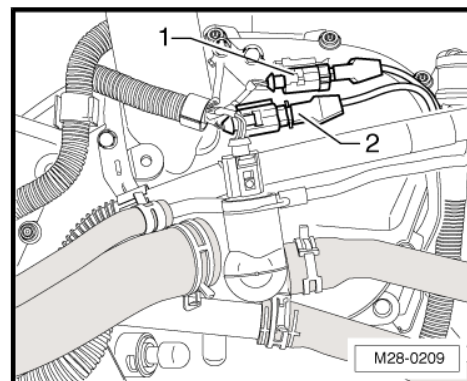
- ☐ No replacement part





Installation position of harness connectors for knock sensors

- 1 - Green for Knock Sensor 1 - G61-
- 2 - Gray for Knock Sensor 2 - G66-





3 Diagnosis and Testing

⇒ **"3.1 Test Data and Spark Plugs", page 256**

3.1 Test Data and Spark Plugs

Engine Code	BGP, BGQ, BTK, CBTA, CBUA, CCCA
Ignition sequence	1-2-4-5-3
Spark plugs	Refer to the Parts Catalog.
Electrode gap	1.0 to 1.1 mm
Tightening Specification	25 Nm
Change intervals	⇒ Maintenance ; Booklet ; Maintenance Tables





4 Removal and Installation

⇒ **"4.1 Ignition Coils with Power Output Stages", page 257**

4.1 Ignition Coils with Power Output Stages

Special tools and workshop equipment required

- ◆ Puller - Ignition Coil - T40039-

Removing

- Remove the engine cover with air filter. Refer to
⇒ **"4.1 Engine Cover with Air Filter", page 216** .
- If present, disconnect the connector from the Secondary Air Injection Solenoid Valve - N112- -arrow-.

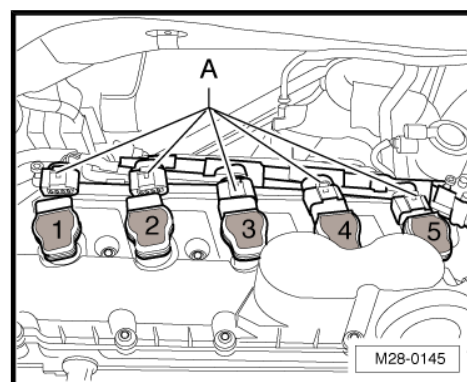
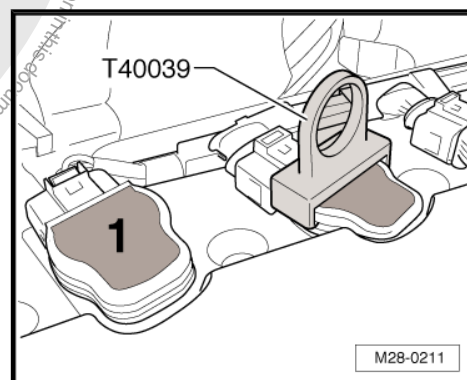
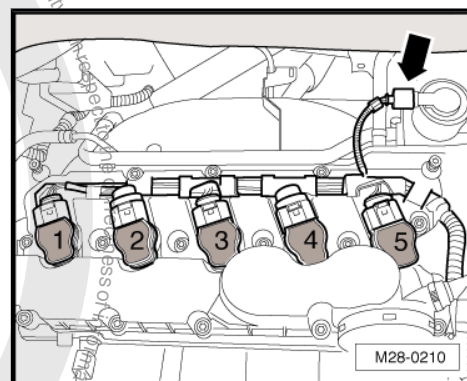
In order to prevent damage to the cable guide, remove the ignition coils with power output stage as follows:

- Using the Puller - Ignition Coil - T40039- , pull all ignition coils only approximately 10 mm out of spark plug shaft, starting with ignition coil -1-.
- Then pull all ignition coils another 10 mm in the same sequence.
- Disengage all the connectors and pull them out only slightly.

- Disconnect all the connectors -A-, beginning with ignition coil -1- and then remove all ignition coils from the spark plug shaft.

Installing

- Insert all ignition coils loosely into the spark plug shaft.
- Align ignition coils to recesses in cylinder head cover and connect all connectors in reverse order of removal on to ignition coils.
- Press ignition coils evenly onto spark plugs by hand.





5 Special Tools

Special tools and workshop equipment required

- ♦ Puller - Ignition Coil - T40039-



6 Revision History

DRUCK NUMBER: MEX5R005121

Fac- tory Edi- tion	Edit Edi- tion	Job Type	Fee dba ck	Notes	Quality Checke d By
10.2 014	04/1 4/20 17	Lo- cal Feed back	124 568 6	Change spark plug torque from 25 Nm to 20 Nm	Eric P.
10.2 014	10/0 5/20 16	Lo- cal Feed back	120 387 8	Changed torque value from 25 Nm to 9 Nm on item # 19 in the Overview - Engine - Side Coolant Sys- tem Components	Eric P.
10.2 014	01/0 9/20 15	Cor- rec- tion	N/A	162 Metadata removed. New book/druck number created specific for 162. All 162 repair information was removed from the book from the 12/11/2014 up- date	Tom Perry
10.2 014	12/1 7/20 14	Cor- rec- tion	N/A	Adding 162 metadata. The correct book for 162 is con- sidered missing as of this update	Tom Perry
10.2 014	12/1 1/20 14	Fac- tory Up- date	N/A		Tom Perry

Cautions & Warnings

Please read these WARNINGS and CAUTIONS before proceeding with maintenance and repair work. You must answer that you have read and you understand these WARNINGS and CAUTIONS before you will be allowed to view this information.

- If you lack the skills, tools and equipment, or a suitable workshop for any procedure described in this manual, we suggest you leave such repairs to an authorized Volkswagen retailer or other qualified shop. We especially urge you to consult an authorized Volkswagen retailer before beginning repairs on any vehicle that may still be covered wholly or in part by any of the extensive warranties issued by Volkswagen.
- Disconnect the battery negative terminal (ground strap) whenever you work on the fuel system or the electrical system. Do not smoke or work near heaters or other fire hazards. Keep an approved fire extinguisher handy.
- Volkswagen is constantly improving its vehicles and sometimes these changes, both in parts and specifications, are made applicable to earlier models. Therefore, part numbers listed in this manual are for reference only. Always check with your authorized Volkswagen retailer parts department for the latest information.
- Any time the battery has been disconnected on an automatic transmission vehicle, it will be necessary to reestablish Transmission Control Module (TCM) basic settings using the VAG 1551 Scan Tool (ST).
- Never work under a lifted vehicle unless it is solidly supported on stands designed for the purpose. Do not support a vehicle on cinder blocks, hollow tiles or other props that may crumble under continuous load. Never work under a vehicle that is supported solely by a jack. Never work under the vehicle while the engine is running.
- For vehicles equipped with an anti-theft radio, be sure of the correct radio activation code before disconnecting the battery or removing the radio. If the wrong code is entered when the power is restored, the radio may lock up and become inoperable, even if the correct code is used in a later attempt.
- If you are going to work under a vehicle on the ground, make sure that the ground is level. Block the wheels to keep the vehicle from rolling. Disconnect the battery negative terminal (ground strap) to prevent others from starting the vehicle while you are under it.
- Do not attempt to work on your vehicle if you do not feel well. You increase the danger of injury to yourself and others if you are tired, upset or have taken medicine or any other substances that may impair you or keep you from being fully alert.
- Never run the engine unless the work area is well ventilated. Carbon monoxide (CO) kills.
- Always observe good workshop practices. Wear goggles when you operate machine tools or work with acid. Wear goggles, gloves and other protective clothing whenever the job requires working with harmful substances.
- Tie long hair behind your head. Do not wear a necktie, a scarf, loose clothing, or a necklace when you work near machine tools or running engines. If your hair, clothing, or jewelry were to get caught in the machinery, severe injury could result.
- Do not re-use any fasteners that are worn or deformed in normal use. Some fasteners are designed to be used only once and are unreliable and may fail if used a second time. This includes, but is not limited to, nuts, bolts, washers, circlips and cotter pins. Always follow the recommendations in this manual - replace these fasteners with new parts where indicated, and any other time it is deemed necessary by inspection.

Cautions & Warnings

- Illuminate the work area adequately but safely. Use a portable safety light for working inside or under the vehicle. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.
- Friction materials such as brake pads and clutch discs may contain asbestos fibers. Do not create dust by grinding, sanding, or by cleaning with compressed air. Avoid breathing asbestos fibers and asbestos dust. Breathing asbestos can cause serious diseases such as asbestosis or cancer, and may result in death.
- Finger rings should be removed so that they cannot cause electrical shorts, get caught in running machinery, or be crushed by heavy parts.
- Before starting a job, make certain that you have all the necessary tools and parts on hand. Read all the instructions thoroughly; do not attempt shortcuts. Use tools that are appropriate to the work and use only replacement parts meeting Volkswagen specifications. Makeshift tools, parts and procedures will not make good repairs.
- Catch draining fuel, oil or brake fluid in suitable containers. Do not use empty food or beverage containers that might mislead someone into drinking from them. Store flammable fluids away from fire hazards. Wipe up spills at once, but do not store the oily rags, which can ignite and burn spontaneously.
- Use pneumatic and electric tools only to loosen threaded parts and fasteners. Never use these tools to tighten fasteners, especially on light alloy parts. Always use a torque wrench to tighten fasteners to the tightening torque listed.
- Keep sparks, lighted matches, and open flame away from the top of the battery. If escaping hydrogen gas is ignited, it will ignite gas trapped in the cells and cause the battery to explode.
- Be mindful of the environment and ecology. Before you drain the crankcase, find out the proper way to dispose of the oil. Do not pour oil onto the ground, down a drain, or into a stream, pond, or lake. Consult local ordinances that govern the disposal of wastes.
- The air-conditioning (A/C) system is filled with a chemical refrigerant that is hazardous. The A/C system should be serviced only by trained automotive service technicians using approved refrigerant recovery/recycling equipment, trained in related safety precautions, and familiar with regulations governing the discharging and disposal of automotive chemical refrigerants.
- Before doing any electrical welding on vehicles equipped with anti-lock brakes (ABS), disconnect the battery negative terminal (ground strap) and the ABS control module connector.
- Do not expose any part of the A/C system to high temperatures such as open flame. Excessive heat will increase system pressure and may cause the system to burst.
- When boost-charging the battery, first remove the fuses for the Engine Control Module (ECM), the Transmission Control Module (TCM), the ABS control module, and the trip computer. In cases where one or more of these components is not separately fused, disconnect the control module connector(s).
- Some of the vehicles covered by this manual are equipped with a supplemental restraint system (SRS), that automatically deploys an airbag in the event of a frontal impact. The airbag is operated by an explosive device. Handled improperly or without adequate safeguards, it can be accidentally activated and cause serious personal injury. To guard against personal injury or airbag system failure, only trained Volkswagen Service technicians should test, disassemble or service the airbag system.

Cautions & Warnings

- Do not quick-charge the battery (for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.
- Never use a test light to conduct electrical tests of the airbag system. The system must only be tested by trained Volkswagen Service technicians using the VAG 1551 Scan Tool (ST) or an approved equivalent. The airbag unit must never be electrically tested while it is not installed in the vehicle.
- Some aerosol tire inflators are highly flammable. Be extremely cautious when repairing a tire that may have been inflated using an aerosol tire inflator. Keep sparks, open flame or other sources of ignition away from the tire repair area. Inflate and deflate the tire at least four times before breaking the bead from the rim. Completely remove the tire from the rim before attempting any repair.
- When driving or riding in an airbag-equipped vehicle, never hold test equipment in your hands or lap while the vehicle is in motion. Objects between you and the airbag can increase the risk of injury in an accident.

I have read and I understand these Cautions and Warnings.